THE INVENTION OF THE ELECTRIC SPEAKING TELEPHONE.

In suits brought in the United States on the Speaking Telephone Patent 174,465, of Alexander Graham Bell, granted March 7, 1876, it has been judicially decided that he was the first inventor of any electric speaking telephone, and that he was entitled to the broadest claims which the law awards to the inventor of a new art. Before this decision was reached the subject was carefully investigated. The depositions of all the claimants then heard of were taken at great length, and each brought forward all his *pièces justificatives*, and also produced as witnesses those who had taken part in his early experiments. This mass of testimony has been printed, and an examination of it confirms the position which Mr. Bell has always held as the first inventor.

Mr. Bell's patent of March 7, 1876, contains the description to which he made oath Jan. 20, 1876, and which was filed in the Patent Office, Feb. 14, 1876. That patent states the discovery that in order to transmit articulate speech by electricity, one must produce on the line wire electrical undulations which in " form " as well as in frequency are similar to the sound waves which constituted the articulate speech to be transmitted, using the phrase " form of vibration " in the precise sense in which it was employed by Helmholtz, with whose discoveries on the nature of articulate sounds Mr. Bell was perfectly familiar. The claim which the courts have decided that Mr. Bell was entitled to make, is the claim that he is the first inventor of that method of transmitting vocal and other sounds which consists in " causing electrical undulations, similar in form to the vibrations of the air accompanying said vocal or other sounds."

The patent contrasted what it called an undulating current with an intermitted or interrupted current, and explained that the instruments described never interrupted the current, and that this also controlled not merely the period or rate of its changes, but the

character of its changes or the force of the current at each instant. It proceeded to show how these undulations could be produced by vibratory motion of some part of the transmitting instrument, and in such manner that the character of the electrical variations would copy and conform to the character of that vibratory motion. It then showed how, by attaching the effective part of the transmitter to a stretched membrane, even the sound vibrations caused by the human voice could be caused to impart their peculiar motions to the operative portion.

Here, then, the chain of causation was complete. The vocal organs moved the air particles; the air particles moved the membrane; the membrane moved the operative part of the transmitter; the motion of that part caused the variations in the current. But this was not all that was needed or that was done. It was further necessary that the voice, and nothing else, should cause motion in the transmitter; that this motion in the transmitter, and nothing else, should cause the changes in the current; and finally, that nothing should interrupt this chain of causation for the minutest instant. When all these conditions were provided, and not until then, the vocal organs would produce on the line wire electrical variations which would be similar in form to the vibrations which the same organs produced in the air.

At the receiving station these electrical undulations must again be translated with fidelity into air motions of sufficient violence to be sensible as distinguishable sound. Here was provided a stretched membrane with a soft iron armature attached to its centre; opposite to this was placed an electro-magnet, the coils of which were connected with the line wire, through which a battery current passed. This current, normally uniform, caused the magnet to draw towards it the armature and stretched membrane so far as the elasticity of the latter would permit. When the transmitter, under the influence of the voice, increased the current, the membrane was drawn nearer to the magnet; when the current was diminished, it flew back; and the greater the electrical changes in the line, the more violent would be these motions.

As the vibratory motions thus set up were caused by the electrical changes which controlled them in the extent or amplitude of the

variation as well as in its frequency, the motions of the one would in form and character copy the undulations in the other. Here another link was added to the chain; the motion of the membrane at the receiving station was due to and therefore controlled by the electrical variations; they in turn were due to, and controlled by, and conformed to the motion in the transmitter, and thus the membrane at the receiving station copied every motion performed by that at the transmitting station. As the movement of the one was caused by and conformed to the sound waves, so the similar motion of the other would cause similar sound waves, and the consequence was as stated by Mr. Bell in his patent, "A similar sound to that uttered against one membrane is heard to proceed from the other."

It is obvious that a vibrating circuit breaker, even if operated by the voice, would not serve as a transmitter, for, not to mention other objections, the circuit would be interrupted during a considerable part of each vibration and thus those nicer and intermediate changes in the vibration *to which*, according to Helmholtz, *articulate character is due*, would not be reproduced in the electrical changes. The instrument, therefore, must never lose its control over the electrical condition of the line wire; and it will lose its control if it makes and breaks contact at each vibration.

Mr. Bell, in his patent, stated several electrical devices by which the motion in the transmitter could control the current as desired. He mentions several types of inductors. The best known of these is the magneto-electric telephone, a drawing and full description of which was given. He also stated, in accordance with the law of Ohm, that the electrical changes could be produced by varying the resistance of an electric circuit supplied with a battery. He stated that this could be done by moving a conducting wire up and down in a liquid which formed part of the circuit.

Here, then, is the whole of the great invention: First, we must employ an unbroken current, the undulations in which must be similar in form to the sound waves; next, these undulatory electrical variations are to be caused or impressed upon the current by motions which the transmitter takes up from the sound waves; finally, these motions can cause the undulations similar in form to themselves by varying the electro-motive force, as in the magneto

transmitter, or by varying the resistance of a battery circuit as by the liquid transmitter. The two great types of instrument, the magneto and the variable resistance, originated with him and are contained in his patent.

This discovery was not the result of chance. From 1867 till 1876 Mr. Bell's time was devoted to the study of articulate speech and sound, and to apparatus for producing sound at a distance by means of electricity. One of his discoveries is mentioned in a note to Mr. Ellis's translation of Helmholtz, p. 161. In the course of them he made great use of a Leon-Scott phonautograph constructed by Koenig, and finally of a phonautograph constructed by himself and the distinguished aural surgeon, Dr. Clarence J. Blake, out of a human ear. In October, 1874, he fully described to Dr. Blake his proposed magneto form of speaking telephone. He did not then construct, it because he feared that the effects produced, though theoretically perfect, would be too weak to be intelligible, and it is probable that the more fully he possessed all then existing knowledge of electricity and electrical apparatus, the more he would have thought so.

He therefore turned his attention to variable resistance battery telephones, and while in the midst of experiments, he discovered that the magneto currents generated by the slight vibrations of a thin steel reed produced audible effects. At once the perfect assurance came to him that the instrument which he had described to Dr. Blake, in October, 1874, was practicable. This was June 2, 1875. He constructed it, continued his experiments to improve its details and its mechanical and electrical perfection, prepared the descriptions for his patent, and obtained it March 7, 1876.

All this history is told in his deposition in one of the printed volumes (Telephone Suits, Vol. I.), and is verified not only by his own vivid recollection, but by his letters and papers written at the time and by the production of the original instruments (though broken), and by the depositions of Dr. Blake and others.

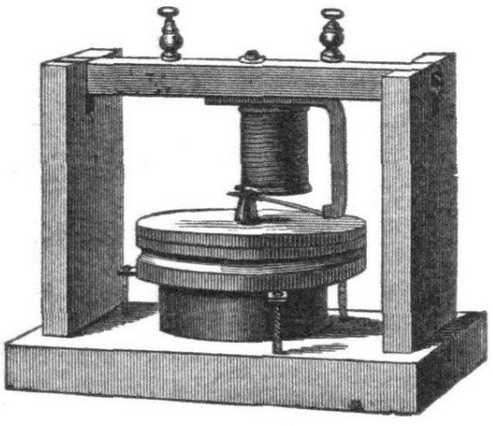
Immediately after the grant of his patent, he devoted himself to the improvement of the magneto telephone, and produced an instrument with the iron diaphragm, the permanent magnet, the small and short core and short coil, and the narrow air space in front of the

diaphragm. These are described in his English specification, filed in London, Dec. 9, 1876, and in his second American patent of Jan. 30, 1877. The model for his American patent is one of a set of actual operating instruments constructed on Oct. 19 or 20, 1876.

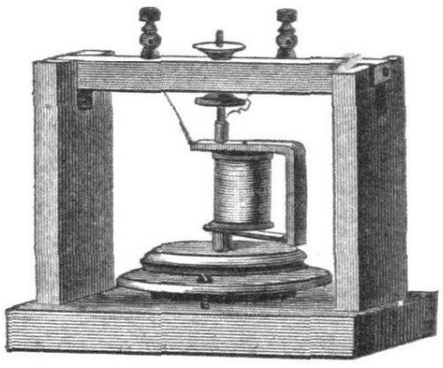
During this time he exhibited his instruments in operation at the Centennial Exposition, at Philadelphia, in June, 1876, and received the applause of the spectators and the award of the judges, whose two reports were drawn by Sir William Thomson and Prof. Joseph Henry. Both of them described its practical success, and spoke of it as "this wonderful result," "a result of transcendent scientific interest," "the greatest marvel hitherto achieved by the electric telegraph."

The instruments there exhibited were a magneto transmitter and receiver and a liquid transmitter. They still exist, and are shown in the following drawings: —

EARLY TELEPHONES OF A. G. BELL.

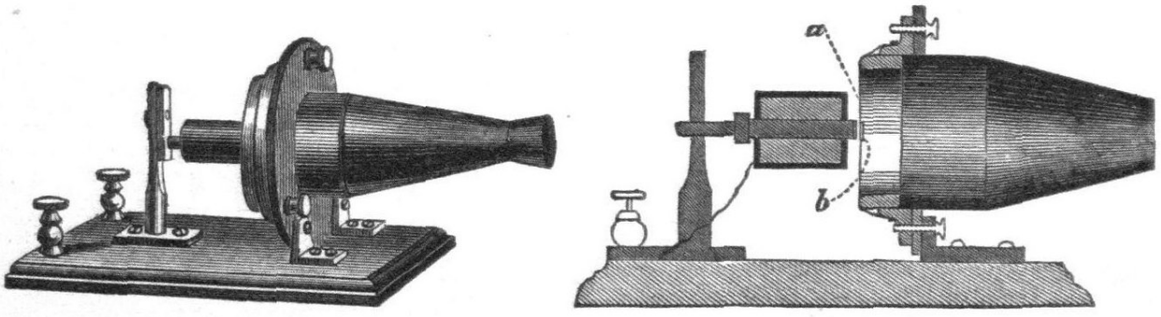


BELL TELEPHONE OF 1875.

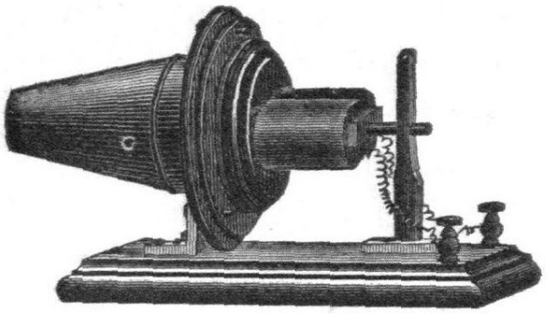


SECOND BELL TELEPHONE OF 1875.

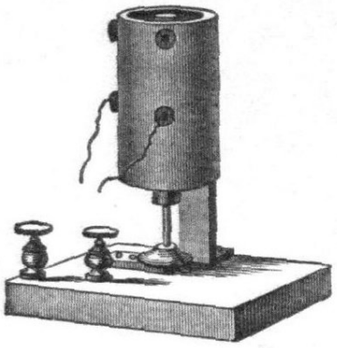
CENTENNIAL TELEPHONES, MADE IN MAY, EXHIBITED IN JUNE, 1876.



BELL'S SINGLE POLE CENTENNIAL MEMBRANE TELEPHONE.



BELL'S DOUBLE POLE CENTENNIAL MEMBRANE TELEPHONE.

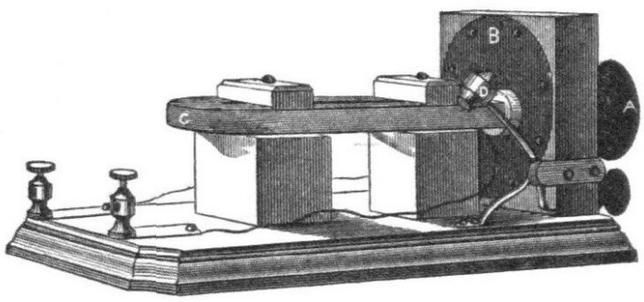


BELL'S CENTENNIAL IRON BOX MAGNET RECEIVER.

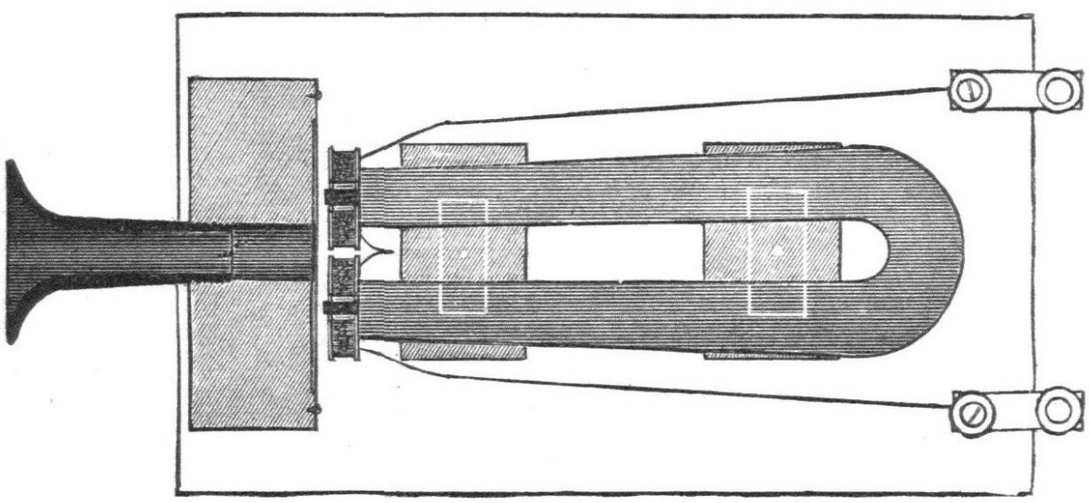
BELL'S CENTENNIAL LIQUID TRANSMITTER.

Immediately after this exhibition, the invention became the subject of constant mention before the most eminent scientific associations, in the scientific periodicals, and in the daily journals. It was exhibited in operation in the principal cities. Long conversations carried on from Boston to Cambridge (seven miles of line used) were reported in the papers. In February, 1877, and soon after, long reports of Mr. Bell's exhibitions were sent by telephone from Salem to Boston, and from Providence to Boston (the latter forty miles), and published in the papers. In the spring of 1877, the Bell Company introduced them into general use; and by Aug. 1, 1877, about one thousand had found actual employment for business purposes.

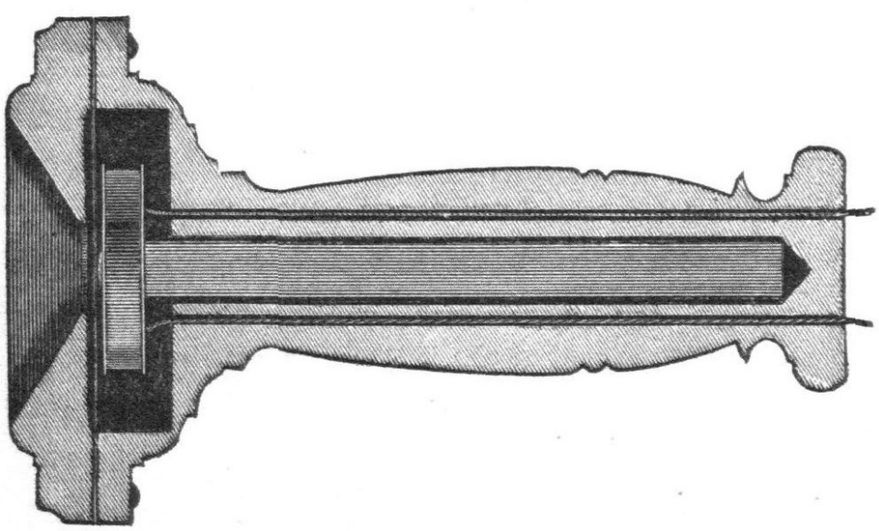
TELEPHONES MADE FOR GENERAL PUBLIC USE BY THE BELL TELEPHONE COMPANY, AT BOSTON.



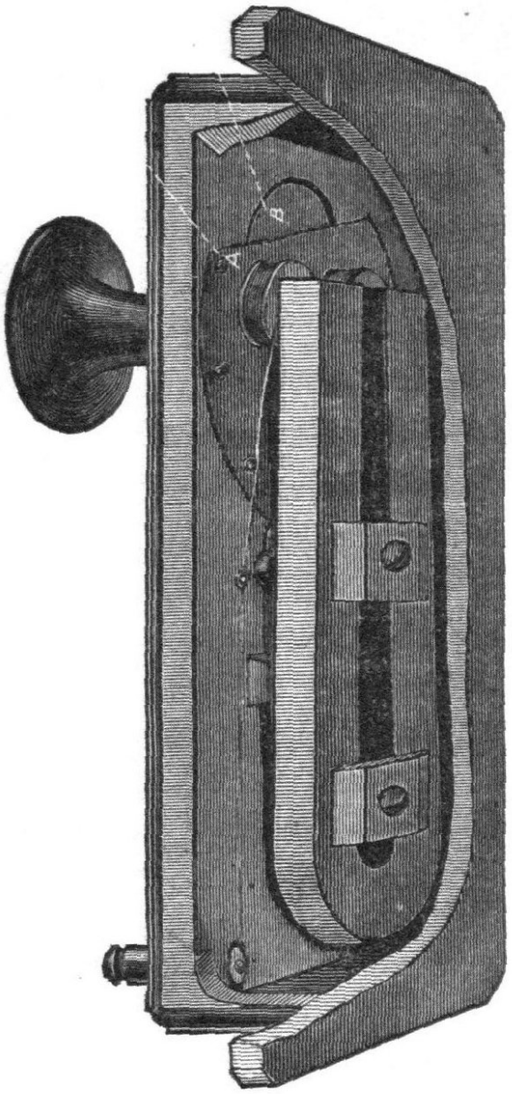
BELL TELEPHONE OF JUNE, 1877.



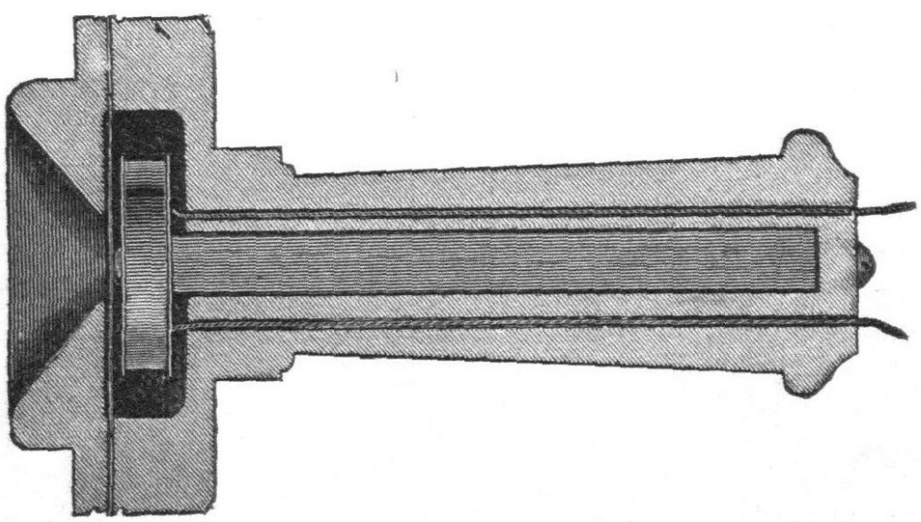
BELL TELEPHONE (NO. 39) OF JUNE, 1877, AS MADE.



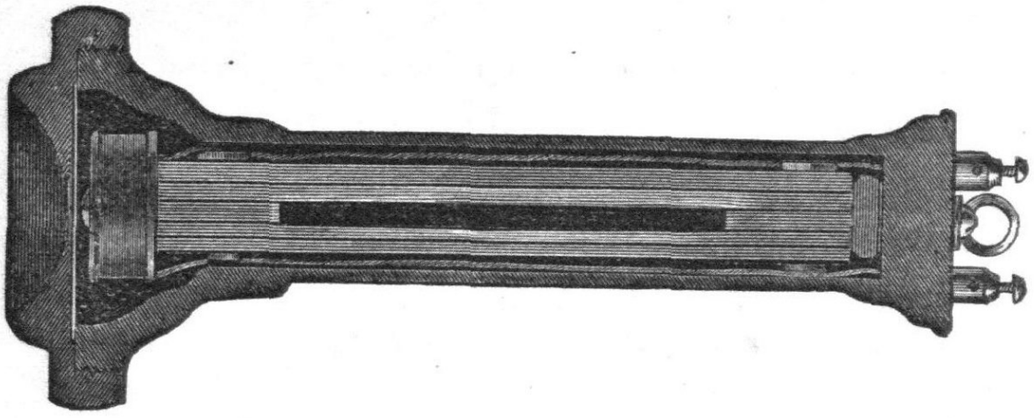
HAND TELEPHONE (NO. 10) OF MAY, 1877.



BOX TELEPHONE (NO. 251) OF AUGUST, 1877.



HAND TELEPHONE (NO. 18) OF JUNE, 1877.



RUBBER HAND TELEPHONE, IN USE SINCE DECEMBER, 1877.

At the present time in the United States more than 150,000 are in use. Twenty-five thousand of these are magneto transmitters, used as transmitters without a battery. The history of the introduction and use of the telephone is told in the depositions of Mr. Watson and Mr. Williams in the pamphlet "Evidence for A. G. Bell," together with large excerpts from the publications of the period and drawings of the different forms of instruments used.

Up to August or September, 1877, the whole world had considered Mr. Bell as the first inventor and had honored him accordingly. No one else, publicly, at least, had laid any claim whatever to the great invention. It was from Mr. Bell and from Mr. Bell alone that the world had learned how to transmit speech by electricity, and all the instruments known were obtained from him or professedly copied from his.

At this time, in August and September, 1877, the invention had assumed considerable commercial importance. The great Western Union Telegraph Company, which controlled nearly all the lines in the United States, determined that its interests required it to possess itself of the telephone, and as part of their scheme for that purpose they then instituted the first attack ever made upon Mr. Bell. As part of that scheme, they set up Mr. Gray and Mr. Edison as prior inventors, and caused those two gentlemen to file applications in the Patent Office.

The Bell Company sued the Western Union Company on Mr. Bell's patents; two volumes of testimony ("Telephone Suits," Dowd case) were taken and printed, and then the Western Union Com-

pany and their counsel became satisfied that Mr. Bell was the first inventor. Without further contest a decree was entered establishing Mr. Bell's great claim.

CLAIMS OF MR. GRAY AND MR. EDISON.

We will now examine all the evidence taken on behalf of Mr. Elisha Gray and Mr. Thomas A. Edison.

Certain indisputable and controlling facts appear at the outset. If they believed that they were really the first inventors, it is absolutely inconceivable that they should have remained silent for a year and a half, while the world was awarding the whole credit to Mr. Bell. It is inconceivable, if they were the first inventors, that Mr. Bell alone should have communicated his knowledge to the public; and yet such are the facts.

On the other hand, it is quite in accordance with the experience of mankind, that after (and only after) Mr. Bell had perfected and introduced his invention, and it had reached the stage when great profit seemed certain to accrue, a powerful and hostile corporation should seek to obtain the great prize by putting forward as first inventors persons who had conceived vague ideas, but who were not earlier than Mr. Bell in their conceptions (when Mr. Bell's dates were proved in the suit), and who had really accomplished nothing at the time when his patent issued.

This is history, and the presumptions from it are overwhelming. These presumptions are still further increased by the fact that both of these claimants had ample means and facilities for experiment and the construction of apparatus, and had long been in the habit of promptly making known and securing to themselves by patents all their inventions.

It may further be remarked that the electrical contrivances employed in the earlier telephones were quite simple, and depended upon well-known principles. *The realization of how electricity was to be employed* was the key to the problem, and there the observation of Clerk Maxwell is very pertinent that the acoustic part, and the knowledge of the nature of speech, was that which the inventor needed to start from. Mr. Bell, he said, was not an electrician who wanted to speak: he was a speaker who, to gain his ends, employed electricity.

THE CASE OF MR. ELISHA GRAY.

Mr. Gray was an electrician who had made and patented many electrical inventions of value. He had been the superintendent of a large machine shop for the manufacture of electrical apparatus, and had retired therefrom in order to devote himself to his inventions. In December, 1875, he saw in the streets of Milwaukee a string telephone, and reflection on this was what ultimately led to his first ideas on the transmission of speech. He and his assistant, Mr. Goodridge, in their depositions, do not exactly recollect the date, but place it about December, 1875. It has been established by the testimony of another witness, a dealer in toys in Chicago, that these instruments were first made in the United States at that time, and reached Chicago during the first week in December, 1875.

This proves that Mr. Gray's first conceptions had their rise *after* that. He does not tell us how soon after. He went to Washington on business connected with his various patents for harmonic telegraphy on Jan. 15, 1876, and stayed there more than a month. Feb. 11, 1876, he made a rude sketch of a liquid transmitter and magneto membrane receiver. Feb. 14, 1876, he caused a caveat therefor, that is, a description and drawing of it, to be deposited in the secret archives of the Patent Office, stating, according to the form of the law, that he did so to protect himself while perfecting his invention. This sketch of Feb. 11, 1876, is the first evidence or suggestion of any definite conception, or of any attempt to communicate any ideas to others.

No instrument was constructed. This description was sworn to Feb. 14, 1876. He first testifies that it was prepared not more than a few days before, and afterwards stated in a second deposition that the sketch made and dated Feb. 11 was part of the instructions for it. Mr. Gray knew of the issue of Mr. Bell's patent very soon after it was granted. At the Centennial Exposition, at Philadelphia, he exhibited a harmonic telegraph in competition with the harmonic telegraph of Mr. Bell. On June 25, 1875, he showed his harmonic telegraph in operation to the judges and a large company of persons, and these passed directly from an examination of his work to the memorable public operation of Mr. Bell's speaking telephone.

Mr. Gray was among those present. He testifies that he himself held the receiver to his ear, heard a sentence, repeated it to the audience, and they applauded (Telephone Suits, Vol. I. pp. 127, 138, 139, Gray's deposition). He testifies that this was the first attempt to transmit the human voice which he had ever heard. Up to that time he had never attempted to construct an instrument.

Even all this did not induce Mr. Gray to make any claim that he had invented a telephone. But the next day he and his assistant constructed some rude kind of a liquid transmitter, tried it, and could transmit nothing with it. It was never shown to any one and was thrown away, or at least never preserved. It does not now exist.

In February and March, 1877, he was about to give a public exhibition in Chicago of his harmonic telegraph in which, by means of tuned reed vibrating circuit breakers, he transmitted musical notes. Thereupon he wrote to Mr. Bell as follows: —

"CHICAGO, Feb. 21, 1877.

"PROF. A. G. BELL:

"*My Dear Sir*, — I give a lecture in McCormick Hall, this city, Tuesday evening, 27th inst., on the *Telephone* as I have developed it. I also connect with Milwaukee and have tunes and telegraphing done from there. I should like to explain and exhibit your method of transmitting vocal sounds as well, but do not feel at liberty to do *more* without permission from you. I should explain it as *your* method and not mine, although the *Office* records show a description of the talking telegraph filed by me the *same* day yours was filed. The description is substantially the same as yours. I was unfortunate in being an hour or two behind you. There is no evidence that either knew that the other was working in this direction.

"With our facilities I can get up an apparatus on a day's notice that will answer. I have a copy of your last patent. Please telegraph at my expense, on receipt of this, Yes or No, and I will act accordingly. Yours truly,

"ELISHA GRAY,
"220 Kinzie Street, Chicago."

The following extracts are taken from this correspondence, the whole of which is printed in "Telephone Suits," Vol. I. pp. 146–152: —

"BOSTON UNIVERSITY, March 2, 1877.

"ELISHA GRAY, Esq., *Chicago:*

"*My Dear Sir*, — I was somewhat hasty I must confess in sending my telegram, for of course you are not responsible for all the ill-natured remarks that may appear in the newspapers concerning me.

"I am sorry that my telegram should have prevented you from making the experiments you desired, for it is my sincere desire to oblige you in any way I can. I am glad that you are willing to do me justice, and must thank you for saying a good word for me occasionally. I may say that it has uniformly been my custom to make honorable mention of your name in multiple telegraphy and to give you the credit of being an independent inventor.

"I have not generally alluded to your name in connection with the invention of the electric 'telephone,' for we seem to attach different significations to the word. I apply the term only to an apparatus for transmitting the voice (which meaning is strictly in accordance with the derivation of the word), whereas you seem to use the term as expressive of any apparatus for the transmission of musical tones by the electric current.

"I have no knowledge of any apparatus constructed by you, for the purpose of transmitting vocal sounds, and I trust that I have not been doing you an injustice. It is my sincere desire to give you all the credit that I feel justly belongs to you.

"I do not know the nature of the application for a caveat, to which you have referred as having been filed two hours after my application for a patent, excepting that it had something to do with the vibration of a wire in water, and therefore conflicted with my patent. My specification had been prepared *months* before it was filed, and a copy had been taken to England by a friend. I delayed the filing of the American patent until I could hear from him. At last the protests of all those interested in my invention, deprecating further delay, had their effect, and I filed my application without waiting for a conclusion of negotiations in England. It was certainly a most striking coincidence that our applications should have been filed on the same day.

"I have been kept so busy during the past few days correcting the examination papers of my normal school, that I have been unable to write. In haste,

"Yours truly, ALEXANDER GRAHAM BELL."

"CHICAGO, March 5, 1877.

"PROFESSOR BELL:

"*My Dear Sir*, — I have just received yours of the 2d inst., and I freely forgive you for any feeling your telegram had aroused.

I found the article I suppose you refer to in the personal column of the *Tribune*, and am free to say it does you injustice.

"I gave you full credit for the talking feature of the telephone, as you may have seen in the associated press despatch that was sent to all the papers in the country, in my lecture in McCormick Hall, Feb. 27. There were four different papers represented at the lecture, but only one, the *Tribune*, alluded to my mention of you, except the press despatch. I described your apparatus at length by diagram.

"Of course you have had no means of knowing what I had done in the matter of transmitting vocal sounds. When, however, you see the specification, you will see that the fundamental principles are contained therein. I do not, however, claim even the credit of inventing it, as I do not believe a mere description of an idea that has never been *reduced to practice*, in the *strict sense* of that phrase, should be dignified with the name invention.

"Yours very truly,

"ELISHA GRAY."

April 2, 1877, Mr. Gray repeated his lecture and exhibition about his musical telephone in New York. The following is part of the report in the New York *Tribune* of the following day, and Mr. Gray testified that it was a correct report: —

"After the first part of the programme had been executed, Mr. Elisha Gray came forward and addressed the audience. He was aware that great confusion existed in the popular mind as to what this telephone could perform; in particular, it had been confounded with the speaking telephone invented by Prof. A. Graham Bell, of Boston. Prof. Bell, Mr. Gray said, was present in the audience."

All this conduct on the part of Mr. Gray is that of an honest gentleman who knows that Mr. Bell and not himself is the first inventor of the electric speaking telephone. It is only to be regretted, that six months later he forgot this and permitted the Western Union Telegraph Company to make in his name claims which he had already declared could not be sustained.

Mr. Bell was the first to construct instruments; he was also the first to conceive of the invention. His conceptions were long prior to Mr. Gray's. He had described the magneto form to Dr. Blake in October, 1874; in the spring of 1875 he was striving to devise an instrument to vary the resistance. His earlier draughts of his specification (Telephone Suits, Vol. I. p. 487) mention this type. His

specification was sent to Washington early in December, 1875, and was entirely completed, copied, and sworn to Jan. 20, 1876. These dates alone, indeed the specification itself, goes back of Mr. Gray's first ideas, which could not have been before the middle of January, and of which there is no evidence and no reduction to the form even of a sketch until Feb. 11, 1876.

Mr. Gray did not transmit a word with an instrument of his own construction until after the spring or summer of 1877.

It is to be noticed again, here, that although Mr. Bell's patent gives no drawing of a variable resistance (liquid) transmitter, it describes one so clearly that an electrician would understand it and could construct it. Mr. Gray expressly says this in his letter already quoted, "I should explain it as *your* method and not mine, although the Office records show a description of the talking telegraph filed by me the same day yours was filed. *The description is substantially the same as yours.*"

Mr. Gray's caveat described a liquid transmitter only.

THE METALLIC DIAPHRAGM.

In Mr. Bell's first patent the diaphragms were of stretched membrane, with an armature attached. In his second patent, No. 186,787, of the United States, granted Jan. 30, 1877, and in his specification filed in London, Dec. 9, 1876, for his English patent, No. 4,765, he says that an iron plate, preferably circular, supported at its edges, will serve both for diaphragm and armature in a speaking telephone, and can be thrown into vibration both by the sound waves at the transmitter and by the magnetic variations in the receiver; he claims this as his invention, and his patent granted it to him.

This improvement rests upon the discovery (and the practical utilization of it in the speaking telephone) that a plate which presented metal enough to serve as an armature, and was so thick as to be stable enough to maintain itself by its own elasticity without artificial stretching or straining, would yet vibrate so easily, and in such a varied and complex manner, that it would on the one hand take up the requisite amount of motion from sound waves with perfect truth of character, and on the other hand would, under the influence of the

slight magnetic changes due to the very small range of variation in telephonic currents, vibrate with sufficient amplitude and accuracy, in conformity with both fundamental and overtones, to reproduce an articulate sound which should be both audible and clearly recognizable.

The experiments of Savart and others had made it certain that at rates corresponding to the fundamental of ordinary speech, and under the powerful impulses of a fiddle bow or of strong *intermittent* currents passed through the coils of a powerful electro magnet, audible vibrations could be produced; but Bell's discovery went further than that, and his utilization of the plate in a speaking telephone depended upon knowledge which science did not previously possess.

Indeed, the experience with Leon-Scott's phonautograph, and with the Reis telephones, had led to the belief that only the very *thinnest* membranes were delicate enough for the purpose. (See M. Leon-Scott's articles and French patent, and the description of the Reis apparatus in *Pisco*, p. 101, and in *Dingler*, Vol. CLXVIII., p. 185, both of which state that the membrane must be fine and not thick.)

Mr. Gray claims that he was the first to make this invention, but it is quite certain that he never made the discovery upon which it rests, and at the date of Mr. Bell's patent did not even know that a metal plate could be used for this purpose.

In 1874 Mr. Gray constructed three "common receivers"; that is, electro magnetic acoustic instruments which would give audible sounds of a pitch corresponding to different rates of intermittences in currents passing through the helix of the actuating electro magnet. He used these devices with circuit-breaking transmitters, by which, of course, the electrical variations were of the great range of strength due to throwing on and shutting off the whole power of a battery which, in the only authenticated drawings extant, is represented as of six cells in the primary of an induction coil, in the secondary circuit of which the receiver was placed.

One of these receivers, described in his English patent 2,646, July 29, 1874, and his American patent, No. 166,096, July 27, 1875, consists of an upright electro-magnet with a metal box about one inch deep and four inches in diameter laid on its poles. The patent says that the sound is produced by the elongations of the mag-

net when the current passes; this well-known device had long before been used by Reis and others *as a common receiver*. Mr. Gray's patent adds that the metal box placed on the poles serves to "intensify the sound." This does not at all indicate the operation of a diaphragm supported by its edges, and not touching the magnet and of itself the principal and only practically effective source of sound.

He also soon after constructed two instruments which did have circular plates supported by the edges in front of electro magnets. They were very rude. One was a tin wash-hand-basin, with an electro magnet placed opposite the inside of its bottom, and the other was a common tin cup with an electro-magnet similarly arranged in it. The tin-cup instrument was destroyed long ago, only a small part of it being found in the heap of waste material at the machine shop. The wash-basin receiver was placed in a trunk, which was lost for a year or two, and then found, and in that way it was preserved. No duplicates existed until 1879, when they were made to be exhibited in litigation with Mr. Bell's patent.

Now it is very significant that of the three instruments thus made, the one which alone was thought worth showing in a patent was one which is not at all Mr. Bell's plate supported at the edges and free at the centre, and that this one alone should be preserved and the others, after some experimental use, thrown away or supposed to be lost and never reproduced.

It is certain that Mr. Gray did not know that such plates would answer the purposes which we have described as necessary for a speaking telephone, because he never attempted to vibrate them by sound waves or by feeble telephonic currents, and never attempted (for he had no speaking telephone transmitter) to cause them to reproduce the *character* of articulate vibrations.

It is also certain that in 1876 he did not believe, and his assistant, Mr. Goodridge, who aided in their original construction, did not believe, that they could be used for a speaking telephone, for his caveat description, prepared with the assistance of Mr. Goodridge, expressly says that the diaphragms are to be "of some thin substance, such as parchment, or gold-beaters' skin, capable of responding to all the vibrations of the human voice, whether simple or complex," and to the diaphragm of the receiver is to be "attached

a piece of soft iron." The convenience and durability of metal are so obvious that it is certain that Mr. Gray would have stated his old experimental instrument if he or Mr. Goodridge had believed that a metal plate was "capable of responding to all the vibrations of the human voice."

Mr. Bell's receiving instrument, to which Mr. Gray listened at the Centennial Exposition, had an iron diaphragm. Mr. Gray's letter of Feb. 21, 1877, already quoted, stated that he has a copy of Mr. Bell's patent of Jan. 30, 1877, in which Mr. Bell claims this invention.

But Mr. Gray never objected to this claim, nor opened his mouth to claim it for himself until he lent himself to the attack which the Western Union Telegraph Co. made on Mr. Bell in the fall of 1877.

It is clear, therefore, that while Mr. Gray had the materials at hand, he had not made the discovery, and did not think that he had made the discovery embodied in this invention before Mr. Bell's patent appeared.

THE MAGNETO TELEPHONE.

Neither Mr. Gray nor Mr. Edison dispute with Mr. Bell the magneto transmitter. Mr. Gray expressly testifies (Telephone Suits, Vol. I. p. 127) that this instrument he believes to have been new with Mr. Bell. Mr. Edison, in his deposition (Edison's Case, Vol. I. p. 115), also testifies that it was the invention of Mr. Bell; that he first heard of it after Mr. Bell's Centennial exhibition, and then did not believe it could work. In the same connection, Mr. Edison testifies that he wrote Chapter VI. of the book called "The Telephone," etc., published by Mr. George B. Prescott in 1878; that in that chapter as he wrote it, he expressly gave full credit for this to Mr. Bell, but that this passage was suppressed without his knowledge after the MSS. was delivered to Mr. Prescott, and that Mr. Prescott was an officer of the Western Union Telegraph Company at that time.

THE CASE OF MR. THOMAS A. EDISON.

Few men have done more to improve speaking telephones than Mr. Edison, but he was not the first inventor of them.

Mr. Edison was in the employ of the Western Union Telegraph Company, to whom his electrical inventions belonged. April 27,

1877, he filed an application for a patent for an "*improvement* in speaking telegraphs." July 20, 1877, he filed another application with the same title. It was not until the fall of 1877, and as part of the proceedings of the Western Union Telegraph Company, that any claim was made by any one on his behalf that he was the first inventor of the electric speaking telephone. His evidence and that of his assistants have been taken and clearly disprove such a claim.

In July, 1875, he began to work on harmonic multiple telegraphy. To aid him in that he procured in July, 1875, a manuscript translation of an article, by Legat, which described a Reis telephone. On the back of it he made, in July or August, a rough pencil sketch, which he says represents a rude form of liquid transmitter for speech. *The receiver shown is a tuning fork.* This proves clearly that he did not even possess the faintest idea of the nature of speech. The instrument sketched, he says, was never made.

In July, 1876, Mr. E. H. Johnson, his assistant, informed him of Mr. Bell's Centennial exhibition; and he then went to work and set two of his assistants at work on speaking-telephone experiments, and a number of sketches of this period exist. But not a piece of paper nor an instrument or model exists made before July, 1876, which shows so much as an experiment or an idea on the subject, except the sketch of July or August, 1875, already referred to. There is no reason to believe that any sketch was made during that period, or that any attempt to construct an instrument was then made, except from one passage in the deposition of Mr. Edison himself. A liquid transmitter was made in October, 1876 (seven months after Mr. Bell's patent), and is testified to by Mr. Edison and several of his assistants. Mr. Edison was unable to recollect the date of this instrument within a year, though it was afterwards fixed by a dated paper.

Mr. Edison testified that according to his recollection he made a rude liquid transmitter in December, 1875, but that it would not transmit a single word. If this were true, it would not affect Mr. Bell, both because it was too late in date and because it was entirely inoperative. But it was quite clear that Mr. Edison, testifying five years later, has attributed to 1875 his instrument of October, 1876, because his laboratory assistants have no recollection of any speak-

ing telephones, models, or experiments before July, 1876, or of any liquid transmitter before October, 1876.

Finally in 1879, in the course of a controversy in England, between the owners of Edison's inventions and the owners of Bell's inventions, Mr. E. H. Johnson, Mr. Edison's assistant and agent, published a pamphlet entitled "*Statement as to the Origin and Development of the Telephone.*" Mr. Edison called Mr. Johnson as a witness, and put this pamphlet in evidence. It contains the following (Edison's Case, Vol. I. p. 295): —

"As is above indicated, we find A. Graham Bell, of Boston, Mass., U. S. A., not only working upon the problem simultaneously with Gray, but anticipating him in the belief that its solution was practicable, and as a natural consequence of the more persistent investigation, evolving in advance of Gray and other competitors the practical device, *thus becoming the true inventor of the apparatus for the transmission of speech.* While Bell, however, was thus at work, another inventor, Thomas A. Edison, of Menlo Park, N. J., U. S. A., whose attention had been called to the subject of acoustic telegraphy by the Hon. William Orton, then president of the Western Union Telegraph Company, had already contributed largely to the science of electrical acoustics, and *taking up the subject of the transmission of articulate speech immediately after Bell's announcement of his achievement*, and before he had yet made his device of practical value, soon distanced even Bell himself in the brilliancy of his discoveries and in the practical application of the invention to the requirements of commerce.

"Edison has always fully and freely acknowledged Bell as the original inventor of the magneto telephone, while claiming the right to use this apparatus in the United States as a telephone receiver.

"He has consequently used it for such purpose in connection with his carbon transmitter."

This passage intimates that Mr. Edison claims the magneto receiver of Bell. But his earliest alleged date is December, 1875, and this cannot antedate Mr. Bell's membrane diaphragm magneto receiver which was made many months before. Mr. Edison perhaps intends to assert a claim to *the metallic* diaphragm, but he cannot maintain that claim. It rests on a single instrument constructed in December, 1875. That instrument consisted of a Helmholtz telescopic resonator, one end of which was closed with a diaphragm of sheet-iron, in front of which is an electro magnet. It was intended as an analyzing resonator for a harmonic multiple telegraph.

When Mr. Edison first began to work on speaking telephones, in July, 1876, the result of a month's trial, expressed in a writing, dated Aug. 2, 1876, was that the diaphragm of a receiver *must be of parchment and not of metal*, and thereafter he made the diaphragms of parchment. The only instrument made during 1877 for the transmission of speech, and now preserved, has a parchment diaphragm. The remarks already made about Mr. Gray therefore apply to him.

His model for his American patent was one of a set of practical working instruments made and used about the middle of October, 1876. His note-book contains a drawing and description of its use at the time, and is reproduced in "Telephone Suits," Vol. II. p. 90.

Mr. Bell used a metal diaphragm for a receiver in his Centennial exhibition, June 25, 1876, the instrument being made in May by Mr. T. A. Watson, and he used a metallic diaphragm for a transmitter in July, and described it in his English specifications, prepared in October, 1876. The model for his American patent, as already stated, was one of a set of operative practical instruments made in October, 1877.

Mr. A. E. Dolbear has sometimes made claim to some invention connected with the electric speaking telephone. He probably did invent some improvements, but so far as he conflicts with Mr. Bell, Mr. Bell's is much the earlier. This conflict relates to the use of metal for the diaphragm, and of a magnet permanently magnetized, instead of being polarized by a battery current.

Mr. Bell's Centennial receiver had an iron diaphragm. In July, 1876, he made another instrument with a sheet-iron diaphragm for a transmitter. It still exists, has been produced, and is shown on p. 105, Vol. II., of "Telephone Suits." His English specification, prepared in October, 1876, and filed in London, Dec. 9, describes and claims it.

His first description to Dr. Blake, in October, 1874, was of an instrument with a permanent magnet. Early in July, 1876, he had a permanent steel magnet constructed for use in a telephone (Telephone Suits, Vol. II. p. 86), and the date of it is fixed by the workman's bill for it. It was used as early as July 15, 1876

(Telephone Suits, Vol. I. p. 501). In November, 1876, a telephone was actually worked over a line seven miles long (p. 502). This improvement was described in his English specification.

Mr. Dolbear testified (Vol. I. p. 286): "My first attention to the telephone that I have any memory of now was in August, 1876, at which time I made some experiments on the subject." In a book written and published by him, in the summer of 1877, called "The Telephone," he describes Mr. Bell's exhibition at Philadelphia, and the instruments then used, and says, "This was the first speaking telephone that was ever constructed so far as the writer was aware."

Sept. 20, 1876, he made a rude sketch in his memorandum book of a telephone with a permanent magnet. The nature of the diaphragm was not shown. Within a week or two after that (Vol. II. p. 289) he caused his assistant to make an instrument with a *thin rubber diaphragm*, but no results whatever were obtained with it: it was destroyed. The next step was (Dolbear's deposition, Vol. I. p. 290) that after Christmas, 1876, he began the construction of a pair of instruments with permanent magnets and metal diaphragms, and they were finished "the last part of January or first part of February." Mr. Bell's patent was actually issued Jan. 30, 1877, and he had prepared his specification and constructed and used instruments with these improvements several months before.

SCOPE OF MR. BELL'S INVENTION.

Mr. Bell's invention then covered: first, that method of transmitting articulate sounds by electricity, which consists in employing what we may call articulate electrical undulations, produced by motion caused by the sound waves themselves. All instruments now known for the transmission of speech do it by the employment of this discovery, and all subsequent improvements in the apparatus have been to enable it to be more perfectly practised.

He also invented a magnet receiver and two types of the transmitter: one in which the motion taken up from the sound waves varied the electro-motive force, and one in which it varied the electrical resistance. The best known forms of the first receiver and transmitter are the hand magneto telephone. The two most usual forms of the latter are the soft carbon telephone, invented by

T. A. Edison in 1877, and the articulating microphone, depending on the employment of hard contact electrodes, first invented and disclosed by Mr. Emil Berliner in papers filed in the United States Patent Office early in 1877, and greatly perfected by Mr. Francis Blake in the Blake transmitter.

ORIGINALITY OF THE INVENTION OF THE ELECTRIC SPEAKING TELEPHONE.

James Watt said that the maker of a great invention must pass through three stages in the estimation of the great mass of the public: first, it would be said it was impossible; next, it would be said that he had not done it; finally, it would be asserted that it had long been known. It may be added that when an inventor has reached this last stage of attack he may be certain that both the novelty and the value of his work has become assured. To this habit Mr. Bell is no exception.

After taking part in Mr. Bell's Centennial exhibition, Sir William Thomson (before whom, however, the impossibility vanished in presence of the accomplishment) said to Prof. T. Sterry Hunt (Vol. II. p. 495) that "what yesterday he would have declared impossible he have to-day seen realized, and he declares it is the most wonderful thing he has seen in America."

In the controversy with the Western Union Company, it was asserted that the instruments specifically described in Mr. Bell's patent would not talk, and some unknown person furnished the Western Union Company with two telephones which were worthless for this purpose. Whereupon the Bell Company caused to be constructed twelve pairs, all of which did talk with practical success, and all of which exactly conformed to the description in the patent; the largest had diaphragms $3\frac{3}{8}$ inches in diameter; the smallest had them 1 inch in diameter, the exact size of Fig. 7 of the drawing filed by Mr. Bell in the Patent Office.

These were constructed by different persons in different shops; two pairs were made by Mr. Georges d'Infréville in his own laboratory. They were tried by many independent persons, among whom were Prof. Cross, Professor of Physics at the Massachusetts Institute of Technology, and his assistant, Mr. J. B. Henck, Jr., Prof. Clar-

ence J. Blake, Mr. Georges d'Infréville, Mr. Henry B Renwick. One pair of these were constructed of a pair of "Lover's Telegraph" string telephones, purchased in the street, and mounted with magnets. These instruments and the success which attended their use are described in the depositions of the above-named gentlemen.

THE REIS TELEPHONE.

Finally it is asserted that Philip Reis, of Fredrichsdorff, was the real first inventor of the speaking telephone, and that his well-known instrument is a true articulating microphone. An articulating microphone in the simplest form consists of an electrode mounted on a telephone diaphragm, with another electrode in contact with it, and independently supported; under vibrational movements of the diaphragm, the one electrode presses more or less severely against the other, and these variations of pressure cause corresponding variation in the resistance of the circuit of which the contact forms part.

It is obvious, from what has already been said of the nature of the electrical transmission of speech, and of the essential requisites therefor, that this contact, the variations in the pressure of which cause the desired *articulating* electrical undulations, must always be preserved as a contact, and that the electrodes must never part company so as to break the circuit. It is this feature, indeed, of a varying, but unbroken contact, which constitutes the articulating microphone, without which it is not.

The Reis instrument has been well known since 1861. It was an apparatus in which the vibrating membrane operated to open and close the circuit at each principal vibration (corresponding to the fundamental of the actuating sound); it was intended so to operate and the parts were constructed of the lightness considered best for that purpose. Its absolute incapacity to transmit speech was perfectly understood and recognized, and those who knew it best were most ready to exclaim with Sir William Thomson that Mr. Bell was the first to achieve a result which up to that time science declared impossible by existing means or methods.

It has been suggested rather than asserted that some person now thinks he remembers that he once heard articulate sounds from it;

but a recollection fifteen years old, of a fact never asserted in the interim, is worthless; the power of the imagination in listening to telephones is well known; and it is impossible to believe that such skilful persons as Mr. Koenig and others constructed and operated for many years an instrument which transmitted speech without their knowing it. Finally, the most careful experimenting shows that with the apparatus of Reis *as a whole*, articulate speech cannot now be and consequently in the past never has been transmitted.

It is said that a Reis instrument can now be so skilfully manipulated, *with the aid of the knowledge communicated by the discoveries of Mr. Bell and of the inventors of the articulating microphone*, as to transmit a few words; but if this be so it is quite immaterial. On the contrary, such an exploit would exalt the genius of Mr. Bell and of subsequent inventors; for it would show that it was not lack of materials nor of mechanical appliances which prevented the earlier transmission of speech, but want of the knowledge which is due to these recent discoveries.

It is not a question, however, to be argued; for it is simply absurd to say that the invention of the speaking telephone can be antedated by the work of a man who did not know how to transmit speech, and who carefully provided that all his instruments should operate in a way which made the transmission of speech by them impossible.

It is not the existence of phenomena nor the mere observation of them which constitutes invention, they may lead an inventive mind towards it; but invention means the knowledge of how to reproduce the desired phenomena at will; it has not been made by one who has not done this, nor even approached in the case of the telephone, by one who directs the careful observance of conditions which, if observed, are absolutely fatal to the electrical transmission of speech.

The literature of the Reis telephone is as follows: —

"Jahres-Bericht des Physikalishen-Vereins zu Frankfurt-am-Main," 1862, pp. 57–64.

"Zeitschrift des Deutsch-Oesterreichischen Telegraphen-Verins," Vol. IX., 1862, pp. 125–130.

"Die Neueren Apparate Der Akustik, von Dr. Prof. Fr. Jos. Pisco," 1865, pp. 96–103.

Article and description by Philip Reis, on pp. 241, 242, of the book entitled "Die Neueren Apparate der Akustik, von Dr. Fr. Jos. Pisco," published at Vienna, 1865.

Article in "Dingler's Polytechnic Journal," Vol. CLXIII. p. 185, published in 1863.

Article by M. St. Edmé, from "Cosmos," Vol. XXIV. pp. 349 352, published in Paris, 1864.

Description of the Reis telephone as made by Koenig, found in "Koenig's Catalogue of Apparatus for 1865."

"Hassler's Technical Physics," Vienna, 1866, Vol. I. p. 648.

Atkinson's translation of "Ganot's Physics," 8th edition, 1877, p. 757.

Atkinson's 9th edition of the same book, published in New York in 1869, p. 773.

"Electricity," by R. M. Ferguson, published in London and Edinburgh, in 1867, pp. 257, 258.

"The Telephone," by Prof. A. E. Dolbear, published in Boston in 1877, pp. 103, 104.

"Journal of the Literary and Philosophical Society of Manchester, England," for Nov. 10, 1864.

Du Moncel's "Applications de L'Electricité," Vol. II., page 255, published in Paris in 1854.

Article by Du Moncel in "Comptes Rendus," for Nov. 27, 1877.

The original article by Reis himself, in the Frankfort Journal, contains the following: —

"If now sounds or sound combinations are produced in the neighborhood of the block, so that sufficiently powerful waves reach the opening A, then these sounds cause the membrane B to vibrate. At the first condensation, the hammer-like wire D is pushed back; at the rarefaction, *it cannot follow* the retreating membrane, and the current traversing the strip is broken, until the membrane, forced by a new condensation, again presses the strip (proceeding from *p*) against *d*. In this way *each sound wave causes a breaking and closing of the circuit.*"

The Reis-Pisco article, published in 1865, —

"A current is established or broken by the vibrations of the membrane."

The Legat article, 1863, —

"The lever *c d* follows the movements of the membrane and opens and closes the electric circuit at *d g*, so that at each condensation of the air in the tube the circuit is opened, and at each rarefaction the circuit is closed."

The final prospectus, written by Reis himself, and published in *Pisco* in 1865, —

"If now stray tones are produced before the sound tube S, the membrane and the little angular hammer resting upon it are set in motion, the circuit will for each complete vibration be once opened and again closed."

Dingler's description of Reis says: —

"At every vibration of the membrane an interruption of the current of electricity will be caused, as the point on one strip of platina no longer touches the other strip."

The "Cosmos" article, Paris, 1864, says: —

"The operation of the instrument is easy to understand The vibrations which the operator in front of the mouthpiece impresses upon the air enclosed in the box of the transmitter are repeated by the membrane; and . . . the electrical contacts are necessarily established and broken between the two strips of platinum; hence there is caused in the coil of the receiver a number of intermittances or interruptions in the passage of the current which is necessarily equal to the number of vibrations of the membrane of the transmitter."

In 1865 the instrument was made by M. Koenig, of Paris, under the direction of Reis. Koenig's catalogue of 1865 says: —

"If now we produce before the membrane a sound which causes it to vibrate, each vibration in pushing away the point from the platinum plate will produce an interruption of the current."

The description in Hassler's "Technical Physics," Vienna, 1866, says: —

"The waves of the sound set the membrane M into regular vibrations. . . . The current is interrupted and a similar interruption occurs with every vibration of M."

Ganot's "Physics" says: —

"When the mouthpiece is spoken or sung into, the sounds set the membrane in vibration; this alternately opens and closes the current."

Ferguson's "Electricity," 1867, says: —

"Suppose a person to sing a note at the mouthpiece which produces three hundred vibrations a second, the circuit is broken by the bladder three hundred times."

"The Telephone," by A. E. Dolbear, published in 1877, says: —

"When a sound is made in the box, the membrane is made to vibrate powerfully. This makes the platinum strip to strike as often upon the platinum finger, and as often to bound away from it, thus making and breaking the current the same number of times per second."

To the same effect are the two articles by Prof. Van der Weyde, who has made the Reis apparatus a special study, viz., in *Manufacturer and Builder*, New York, May, 1869, and *Scientific American*, March 4, 1876: —

"At every downward motion the contact of this disk with the platinum point under *b* is broken, and therefore the current is interrupted as rapidly as the vibrations occur."

No description or suggestion that this apparatus had, or was intended to have, or was capable of any other action or mode of operation, was ever made.

It was also recognized that the Reis did not and could not transmit speech. None of the descriptions suggest that it did or could, but the contrary, and some of them are specially explicit.

The first publication of Reis was before the discoveries of Helmholtz as to the nature of articulate sounds had been published, and the reasons of the failure were not well understood. Helmholtz's book appeared in Germany in 1863. Pisco's standard work on "Acoustic Apparatus," published in 1865, says: —

"The apparatus of Reis is indeed a 'telephone,' but not a 'phonic telegraph' [which of course means that it can produce a sound at a distance, but cannot, by sound, convey intelligence so as to take the place of the telegraph], '*the only means of transmitting song and speech, and this only for moderate distances, is the old well-known speaking tube* But the experiment of Reis can always be classed with the most beautiful and interesting of school experiments.'"

Dr. Van der Weyde's article in the *Manufacturer and Builder*, May, 1869, says (p. 774) : —

"It is clear from the foregoing explanations that no quality of tone can transmitted. *Much less can articulate words be sent*, notwithstanding the enthusiastic predictions of some persons who, when they first beheld this apparatus in operation, exclaimed that now we can talk directly through the wire. It is from its nature able to transmit only pitch and rhythm — consequently melody and nothing more. No harmony, nor different degrees of strength or other qualities of tone, can be transmitted."

Prof. Dolbear in his book, 1877, describing the Reis, says of it (p. 92) : —

"In this apparatus we have a telephone with which a melody may be reproduced at a distance with distinctness. But the sounds are not loud, and they have a tin trumpet quality. If one reflects upon the possibilities of such a mechanism and upon the conditions necessary to produce a sound of any given quality, as that of the voice, or of a musical instrument, as described in the preceding pages, he will understand that it can reproduce only pitch."

Then describing Mr. Bell's Centennial exhibition, Prof. Dolbear says (p. 96) : —

"This was the instrument exhibited at the Centennial Exposition, at Philadelphia, and concerning which Sir William Thomson said on his return to England, 'This is the greatest by far of all the marvels of the electric telegraph.' . . . *This was the first speaking telephone that was ever constructed so far as the writer is aware.*"

Finally, the Reis instrument itself, as constructed by Reis and his successors, bears conclusive proof that its inability to transmit speech was actually *recognized as a fact.* It carries at its side an ordinary Morse key and a cheap form of Morse sounder. This was for the purpose of communicating with the operator at the other station; the existence of this addition shows conclusively that the Reis could not transmit an articulate, not even such familiar sounds as the numerals, or the names of the letters. Reis's prospectus of 1865, in *Pisco*, describes it as follows : —

"The telegraphic apparatus represented at the side is not needed for the reproduction of tones, but it furnishes useful results in ordinary experiments; through this it is possible to communicate readily with one at the further end of the line."

And then follows nearly a page with a modified Morse alphabet, and instructions how to spell out words by blows with the key. This same device is part of the instrument as shown in *Pisco*, on the side of the square box, and Pisco says that it is needed as a means of communication between the stations; it is shown and its purpose explained in Hassler, and in Dr. Van der Weyde's article in the *Scientific American*, of March 4, 1876.

It is altogether certain, therefore (whatever hopes Reis may have had before he made his experiments), that the machines he constructed were by him designed to transmit pitch and not articulation; and that the community purchased, accepted and used them with this design and with the belief that this was the limit of their capacity. The instruments carried in themselves evidence of this design, for in addition to the telegraphic key already mentioned, the electrode not attached to the diaphragm was purposely constructed as light as possible, so as to move readily under the influence of the diaphragm, whereas in the articulating microphone they are so constructed as to resist this motion and perform their functions only by resisting, and so far as they resist it, subject always to their new obligations not to break the circuit.

And they not only bring into play, but their operation depends upon an electrical principle not employed by Reis, viz., change of conductivity due to change of contact pressure.

It is therefore clear, —

That no electric speaking telephone existed before 1875, and that science did not know how to transmit speech until it learned it from Mr. Bell.

That it is in fact from Mr. Bell that the public received this new art.

That he is the first inventor of all the features of this instrument claimed by him September, 1881.

MICROPHONES AND CARBON TELEPHONES.

The variable resistance transmitters which are most in use to-day are the soft carbon instrument of Edison and the Blake microphone. One depends upon the variation of conductivity, caused

by compression of a compressible or yielding mass, and the other upon the variation of conductivity at the surface contact of two hard electrodes, caused by variation of pressure between them. Both phenomena had been observed before Bell invented the telephone. The construction of a telephone to utilize the one must be considered a different invention from the construction of a telephone to utilize the other, although in an ultimate analysis both are found to depend upon the same principle. The first description of a microphone ever made is believed to be found in a paper deposited in the United States Patent Office, in April, 1877, by Mr. Emil Berliner. It contains the following: —

"It is a fact and a scientific principle that objects near each other, which are charged with electricity of the same polarity, repel each other. It is also a fact that if, at a point of contact between two ends of a galvanic circuit, the pressure between both sides of the contact becomes weakened, the current passing becomes less intense; as for instance, if an operator on a Morse instrument does not press down the key with a certain firmness, the sounder at the receiving station does work much weaker than if the full pressure of the hand would have been used. Based on these two facts, I have constructed a simple apparatus for transmitting sound along a line of a galvanic current, in the following manner."

The instrument described and shown in the drawings consisted of a strained diaphragm and a small knob or a point in contact with its centre. Upon constructing such an instrument, it is found that it will transmit speech, and will also, though not so perfectly, act as a receiver.

In July, 1877, Mr. Edison deposited in the United States Patent Office an application which showed a similar speaking telephone, except that the contact point was of a composition of plumbago in contact with platinum, and was mounted on a yielding and adjustable spring. This instrument is a practical transmitter.

Prof. Hughes's microphone was invented by him in the early part of 1878. It will be observed that these descriptions were actually filed the year before.

Mr. Edison then devoted himself to the development of the soft carbon form.

The surface contact microphone was brought to its present perfec-

tion in the Blake transmitter, in the summer of 1878, by Mr. Francis Blake, an officer of the United States Coast Survey, who had been for several years occupied with the electrical determination of longitudes.

United States Patent Office.

TELEPHONE INTERFERENCES 2 AND 3.

EDISON — BLAKE — CHINNOCK.

BRIEF FOR FRANCIS BLAKE.

BOSTON:
ALFRED MUDGE & SON, LAW PRINTERS, 34 SCHOOL STREET.
1881.

TELEPHONE INTERFERENCES, 2 AND 3.

BLAKE — EDISON — CHINNOCK.

BRIEF FOR BLAKE — SUMMARY.

In November, 1878, Mr. Francis Blake introduced into commercial use an instrument which was altogether novel to the public, both in its construction and in the ease of its use and the perfection of its results. Its adaptation for the purposes intended has been proved by the public demand, which absorbed 40,000 in eighteen months. Mr. Chinnock and his associates, who had tried to make a telephone fit to manufacture but had not succeeded, saw it, perceived some formal resemblance to an old model which for six months had lain condemned, and filed that model in the Office with a specification. That is their case. We ask the Office to treat it as they treated it, and not to make them a present of the Blake transmitter.

Examining more minutely Chinnock's work, it is apparent why he failed, and that he did fail because he pursued a line of invention directly opposite to that of Mr. Blake. Mr. Blake aimed to construct an instrument which should have the mode of operation of an articulating microphone, and in which the parts should be constructed, proportioned and arranged to that end, and particularly for that feature which is the one great essential for the transmission of speech, — the preservation of an *unbroken* circuit; and in this attempt he entirely succeeded. Mr. Chinnock aimed to construct an instrument whose normal and desired action under the influence of sound waves should be to *break* the circuit more surely and for a longer time than any instrument before made; and in this he succeeded. That this was the true character of his work is shown by the report from his own witnesses of the description and explanations he made at the time, by the description given in his specification, and by the behavior of his instrument under trial. Thus he did not make the same invention as Mr. Blake; and whatever be the

relative dates of their work, Mr. Blake must prevail in every interference which relates to electric speaking telephones.

For the difference we have indicated — that between a contact-preserving variable-pressure microphone, and a circuit breaker — is precisely that which enables one instrument to transmit speech and disables the other from doing so; and though a particular articulating microphone may be so far from perfect that it will occasionally and abnormally break the contact, and a circuit breaker may so far fail to perform its intended functions that occasionally it will not break the circuit, yet this neither abolishes the distinction itself nor makes an improvement in one direction the same invention as an improvement in the other. Nor does the fact that formal resemblances can be found between the two instruments make the two to be the same: not in law, for the law looks to the intellectual conception embodied in the apparatus, and to the mode of operation which it exhibits when in action; not in fact, for the Blake instrument transmits with practical perfection every word spoken in an ordinary tone of voice, while the Chinnock transmits only a word or two now and then, as if by accident, and adds nothing to the convenience of mankind.

Although, by a forced construction or a careless reading, the wording of the issues might seem to fit both instruments, yet it is obvious that no ambiguity of language, whether due to loosely drawn claims or to the haste of the examiner, can require the Office to decide that Chinnock invented the Blake transmitter before Blake, if the evidence shows that he never conceived of such an instrument. But in fact the issues are not so misleading, because, read with reference to the subject matter, they must be taken to be confined to circuit-preserving microphones such as are shown by Blake and Edison, from whose claims two of the issues are copied, and because, moreover, they all refer by their express language, when read by an instructed mind, to instruments which operate by variations of pressure, and with an unbroken circuit.

As between Blake and Edison, it is conceded that, so far as the applications now in controversy are concerned, both were working upon contact-preserving, variable-pressure microphones.

One of Edison's applications, No. 178, filed June 2, 1879, after

he had witnessed Blake's commercial success, has for its model one of Blake's own instruments, procured from Blake's licensees. Such an apparatus had never been made by Edison, and the instruments upon which he bases his claim to priority were for the most part long ago destroyed. Upon these facts, and under the peculiar circumstances surrounding him and his work, it must be held that what he had before thought of (even if it were the same as what Blake had done) but never considered worth practising or claiming, ranks in law among abandoned experiments.

To all such attempts as those made by our opponents the lesson of the sewing-machine patents affords an answer. Such claims to the ownership of inventions which others have made successful fail for several reasons: First, testimony from human lips cannot satisfy, and in sound policy ought not to satisfy, any thoughtful judge that the machine which fails is the same as the machine which has since succeeded, and it is more likely that evidence and memory should fail to point out the difference than that such difference should not exist. And when the machine is produced and worked, as was the case with Hunt's sewing machine and Leavitt's sewing machine, a test for the purposes of evidence is worth little against the proof afforded by rejection of the apparatus by its owners. Finally, the law, conforming to the dictates of experience, has declared that an invention pursued a considerable distance, then dropped unpatented, and without reaching any result of practical utility, does not stand in the way of or impair any of the rights of a subsequent original inventor.

Howe *v.* Underwood, 1 Fish. 162.
Johnson *v.* Root, 1 Fish. 353.
Parham *v.* Am. Buttonhole Co., 4 Fish. 468.
Aultman *v.* Holley, 5 O. G. 6.

The other application of Edison (158, Nov. 11, 1878) contains a feature which covers Case 2, broadly stated, and he is probably entitled to priority on that; but this still leaves Blake entitled to a claim on the special and very excellent and quite different form in which he has embodied the same general principle.

United States Patent Office.

TELEPHONE INTERFERENCES.

BLAKE,
EDISON,
CHINNOCK,

CASES 2 AND 3.

BEFORE THE HON. EXAMINER OF INTERFERENCES.

BRIEF FOR FRANCIS BLAKE.

These interferences relate to improvements in speaking telephone battery transmitters, and the features in controversy are all embodied in the well-known Blake transmitter, used by the Bell Telephone Company.

Mr. Francis Blake was for twelve years an officer of the U. S. Coast Survey, and for a number of years was engaged in the telegraphic determination of longitudes. Thus, in addition to his scientific training, he became practically familiar with electricity, and with the construction and use of instruments of precision in which it was employed.

He originally invented and produced the admirable instrument known all over the world as the Blake transmitter. Early in November, 1878, he arranged for their manufacture with the Bell Telephone Company; they instantly went into public commercial use, and by July 1, 1880, when the proofs were taken, over 45,000 had been put out (Watson, ans. 3, p. 117). They are made precisely in the form shown in his patent; his model was one of those made for commercial use.

Mr. Blake did not invent a new art, as Mr. Bell did; he was not the inventor of a new genus of instruments, in the sense in which the

first inventor of the microphone can be referred to. But he made an instrument consisting of a combination of parts so admirably contrived and proportioned for the particular work upon which the transmission of speech depends that it was at once universally sought for; and this instrument was especially devised for the purpose of carrying out that which is the essential and distinguishing principle of the speaking telephone. It would not be difficult to enumerate on the fingers the principal parts of which it is composed, and to show that before his time speaking telephones had been devised which possessed parts which might be called by similar names, and in forms so like those of Blake that an unskilled person could not state in precisely what the difference consists. Yet there is a difference between the earliest hard electrode battery transmitters or microphones, which were so vastly inferior to the rudest magneto telephone that no one would use them, and Mr. Blake's beautiful instrument, at once the most sensitive and the most reliable of its kind; and no one can doubt that such a difference, which separates success from failure, involves invention.

One result of Mr. Blake's work appears here. The interfering application of Mr. Chinnock, some of the interfering applications of Mr. Edison, were filed after and because those persons and their backers had witnessed the success of Mr. Blake's instrument (*v.* p. 7 *infra*).

In another part of this brief (p. 33 *infra*), we shall give the details of Mr. Blake's work. It is enough to say here that in July, 1878, he devised, in the three following months perfected, and in November, 1878, put into commercial use the most perfect form of transmitter, known. Why should Mr. Chinnock or Mr. Edison prevent him from having a patent on those features which distinguished his instrument from anything the public then possessed?

The Relations of the respective Instruments of the Applicants to Each Other.

Mr. Chinnock's story comes to this: He is an electrician in the employ of the Holmes Burglar Alarm Telegraph Company. Early in 1878, and when telephones made under Mr. Bell's patents were in commercial use to the extent of many thousands, and when bat-

tery transmitters with solid electrodes — now generally known as microphones — had been invented but had not gone into general use, and were not generally known or understood, he undertook to make a new transmitter. The magneto telephones in common use gave excellent articulation, but were weak in sound. His attempt was to make a battery transmitter which should make more noise than anything known. In his project he enlisted his employers, the Holmes Company, who agreed to furnish the requisite means. Two instruments were made, and were exhibited to the Holmes Company and their experts. They were undoubtedly noisy, but they were too deficient in articulation to be of the slighest practical value. From June, 1878, he did nothing till the last of November, 1878. At that time Mr. Blake's instruments, then just introduced into commercial use, were examined by Mr. Holmes and Mr. Chinnock; and immediately the Chinnock instrument of six months before was brought forward, and his present application made and filed.

It is a fact that two different kinds of electrical instruments have been made to be actuated by the voice, each with its own characteristic mode of operation, totally different from that of the other. The one, to use technical language, operated to break and by breaking an electric circuit; the other was intended to never break the circuit, but to vary its resistance. The effect of one is due to its interruptions of the current; the effect of the other is due to the fact that it impresses upon the current a special character of variation without ever interrupting it. The one will make a loud noise, but its mode of operation disables it from transmitting articulate speech; the other produces effects which are much less violent, but it possesses that mode of operation which is the only one that makes the transmission of speech possible. The one can control only the pitch of the sound produced, and thus makes a loud musical telephone (so called); the other can exercise the control which gives those minute but all-important variations or characteristics which constitute articulation. The precise character of these differences is set forth in detail on p. 16 *infra*.

Electricity is an agent at once so delicate and so subtile, so quick to be affected in its action by almost microscopic changes in the instruments employed to handle it (if the expression may be applied

to that which is invisible, imponderable and intangible), that instruments of one of the classes we have referred to can be constructed which will not differ from those of the other by any of the differences which ordinarily and obviously characterize mechanisms which are to act upon ordinary materials, or to deal with nature in its grosser forms. The workman unskilled in electricity can make the apparatus to be a Chinese copy of his drawing or model, but will fail to make it operate as intended; for in most electrical apparatus no mechanical measurement will suffice to put the parts in the exact relations needed for their intended co-operation. But the electrician into whose hands it is put is told of the results desired; of the mode of operation intended; of the manner in which, and the mode by which, the current is to be manipulated and influenced in its passage through the instrument; when it is to be merely weakened, and when it is to be entirely interrupted; what electrical relations the parts must sustain in order to do this: and with this knowledge he has no difficulty in so manipulating the instrument as to put the parts into the relations which are indicated to his mind by the mode of operation directed, rather than by the ordinary instructions of the machine shop.

The rude forms of speaking telephones of the battery class which existed in the winter of 1877–8 very much resembled in their mechanical structure the "harmonic" or "musical" telephones which operated by breaking the circuit. Most of them, under one kind of adjustment and manipulation, could readily be made to break the circuit; and indeed the trouble with all of them was that it was very difficult to prevent them from breaking the circuit when the diaphragm was thrown into vibration by the voice, so that while they generally gave a good volume of sound, they did not articulate properly; or to express it mechanically, though they were intended to so operate as to vary the current without ever interrupting it, yet their mechanical construction was so far from perfect that they sometimes broke the circuit when it was not intended that they should. Now Mr. Chinnock, perceiving that the defect in the magneto telephone (the kind then in use) was the weakness of its sound, while no complaint was made of its articulation, and finding that every break in the circuit increased the loudness of the sound, started off in the

vain attempt to modify a circuit breaker so that the action of the voice upon it should normally cause it more certainly and conveniently so to operate as to break the circuit. This was his work; this was the class of instrument he devised; and every modification he introduced which helped or which involved this mode of operation marked the apparatus as outside the class of speaking telephones, because it caused them to produce a sound of their own, and not the sound of the articulate words which it was intended they should transmit.

On the other hand, Mr. Blake sought from the beginning to make, and in the end succeeded in making, an instrument provided with special devices which should enable it to vary the intensity of an unbroken current, and at the same time should prevent any break in it under any usage which it was likely to be exposed to.

If an examination of the evidence shows such a state of facts as we have narrated, then it is clear that the one apparatus does not anticipate the other, and if the issue describes Mr. Blake's instrument he was the first to make it, because Chinnock never made it.

Mr. Edison's work was undoubtedly of the speaking-telephone class, and the question between him and Blake will therefore be considered separately.

The Case against Chinnock.

History of Mr. Chinnock's Work.

Mr. Chinnock is an electrician, for many years in the employ of the Holmes Burglar Alarm Telegraph Company, and he has made several electrical inventions which they have bought and paid the cost of developing and patenting (Chinnock, ans. 4–6, p. 156). The earliest date he fixes for his first ideas relating to this subject is November, 1877 (ans. 8, p. 157). He says that during that month he made the sketch Exhibit 3 (ans. 15–18, p. 158). His first instrument of any kind was made February, 1878 (ans. 29, p. 161); that no longer exists. He made another in April, 1878, and it is produced as Exhibit 4 (ans. 32, 33, p. 162). It was made by S. Bergmann (ans. 42, p. 163). Afterwards another was made, and cut and changed and altered and completed in its present form about the

middle of June, 1878 (ans. 41, p. 163; cross-ans. 81, p. 172) These are all that have been made by him or any one connected with him, and the last mentioned is the identical instrument which he afterwards filed as his model.

Before making the first of these two, he applied to Mr. Holmes for assistance. Mr. Newbury, of the Holmes Company, who has been aiding in the conduct of these interferences on behalf of the Holmes Company (Newbury, cross-ans. 27, p. 153), is called on the part of that company and of Chinnock, and testified: —

"The subject of telephones was discussed by 'most all the persons connected with the Holmes Burglar Alarm Telegraph Company during 1876." (Cross-ans. 33, p. 154.)

He testifies that before the agreement between Chinnock and the Holmes Company, the latter used telephones furnished by the Bell Company; and he says: —

"The desirability of manufacturing telephones was a subject that was discussed by Mr. Holmes and myself, as well as by Mr. Roome. That the manufacture of telephones would be a profitable investment if they could be manufactured without infringing any existing patent, as we were thoroughly convinced that in time the telephone would be improved from what we knew it of that date, and become a commercial necessity." (Cross-ans. 28, p. 153.)

Thereupon an agreement was made between Chinnock and the Holmes Company, about April, 1878, "to have Mr. Holmes to pay the expenses of whatever experiments he thought necessary in order to see what improvements Chinnock would make in telephones." (Ans. 11, 12, p. 150.) "The company would by this agreement acquire an interest in a patent, if it is granted to Mr. Chinnock for this invention." (Cross-ans. 23, p. 152.)

The Holmes Burglar Alarm Telegraph Company pays the expenses of this interference (cross-ans. 25, p. 152). Mr. Bergmann, the electrical-instrument maker, called for Chinnock, testifies: —

"Mr. E. Holmes sending Mr. Chinnock over to my place with a note, to make anything he desired in experimenting on telephones at his (Mr. Holmes's) expense." (Ans. 6, p. 121.)

Chinnock testifies (ans. 65, p. 168): —

"Had an informal understanding with Mr. Holmes, about February, 1878. In consideration of my taking up the question of the

telephone, I was to give him a certain proportion of the invention, he to pay for apparatus to experiment with, which he did, to S. Bergmann. I had another conversation with him in reference to the improvements in controversy, about April, 1878, the sum and substance of which was about the same as the previous one. I entered into a formal agreement with Mr. Holmes about November, 1878."

He afterwards said that the nearest he could fix the date of this agreement was "the latter part of November, 1878" (cross-ans. 97, p. 175). His application was filed in December, 1878.

The cause of this sudden start in November, 1878, has been disclosed. Chinnock testifies, p. 164: —

"*Int.* 45. State when you first either saw, learned or heard of any telephone transmitter, other than your own, embodying or involving the principle of the improvement in controversy.

"*Ans.* It was the last of November, 1878.

"*Int.* 46. Whose was that?

"*Ans.* At that time there was no name given to it. I heard from Mr. Holmes that there was a transmitter that worked on the same principle as mine. I believe that was in November, 1878.

"*Int.* 47. Did you afterwards learn whose transmitter he referred to?

"*Ans.* I did.

"*Int.* 48. Whose was it?

"*Ans.* Francis Blake's.

"*Int.* 49. When did you learn that?

"*Ans.* Immediately afterwards."

It appears from Mr. Blake's proof that his instruments were first publicly used in New York, Nov. 11, 1878, and at once excited much attention (p. 93).

With all the means, the desire and the motives of the Holmes Company, the sight of Blake's instrument did in a day what six months' contemplation of Chinnock's apparatus had not done; viz., Holmes instantly closed a formal contract with Chinnock and pushed into the Patent Office.

These applications are in terms for "improvements in telephones"; the contemporaneous acts of the Chinnock parties prove that they found no improvement till they found the Blake transmitter, and that the purpose of their applications was not to control what Chinnock had done, but to lay Blake's work under contribution.

A close examination of what Chinnock did accounts for their former conduct as certainly as Blake's success accounts for their present attempt.

The Chinnock Instrument.

Only three witnesses are called who pretend ever to have even attempted to transmit speech with it: Mr. Chinnock himself and his sister-in-law, Miss E. Lahey, then a young girl of eighteen, and Mr. Roome. Leaving for a moment their testimony, which proves hopes rather than results, the evidence shows the following extraordinary condition of things: —

Mr. Holmes in April, 1878, acquired an interest, not in an invention made, but in an invention to be made. Mr. Newbury (ans. 19, p. 151) testifies of the interview when the agreement was made, "No particular improvement was described, as in that conversation Mr. Chinnock claimed that he *could* make improvements, but did not state what they were." Mr. Chinnock testifies (ans. 65, p. 168) that he had an informal understanding with Mr. Holmes in February, 1878, "in consideration of my *taking up* the question of the telephone," and that another conversation was had between them in April, 1878, "the sum and substance of which was about the same as the previous one." Clearly, at that time he had not made any invention, but was trying to.

Then he went to Bergmann's shop and had the work done, which the Holmes Company paid for; the charge for the work is April 30. (Exhibit 1.)

Mr. Holmes was of course himself a skilled electrician, and was familiar with telephones. He had in his employ E. T. Greenfield, an electrical constructor; Mr. Henry C. Roome, superintendent and electrician of the Bankers' and Brokers' Electric Protective Company (p. 178), one of Mr. Holmes's branch companies (cross-ans. 11, p. 185), "especially skilled in electrical apparatus" (cross-ans. 89, p. 173); Mr. H. S. Newbury, who is manager of the time-lock business of the Holmes Company, and who has had charge of these interferences on behalf of that company (cross-ans. 26, 27, p. 153). Mr. Chinnock came in contact with these gentlemen with reference to his invention in April, May, June and July, 1878. He also had

an interview on the subject, July 17, 1878, with Mr. Hall, the assistant of Mr. E. H. Browne, the applicant's solicitor; Mr. Hall has testified as an expert on behalf of Chinnock.

Now, there has never been any difficulty in obtaining a large volume of sound from battery transmitters, particularly those of the solid-electrode class; they all make more noise than the magneto telephones, and the worst of them are the loudest. The difficulty has been to make them articulate distinctly; *i. e.*, to so contrive them that they shall control the quality, *timbre* or character of the sound, and not merely give a volume of unintelligible noise. The reasons for this are referred to on p. 21 of this brief, and are specially developed in Prof. Cross's testimony (p. 202, *et seq.*). In the state of the art at the time Chinnock first took hold, six months after the filing of Edison's application 141 (with which Chinnock's application has been in interference, until Chinnock confessed out of it), the improvement to be made in this class was not in obtaining loud sounds, but in securing an instrument which should give uniformly, and in a practically reliable manner, distinct articulation through a whole conversation. It is in this that the Blake transmitter excels; and it cannot be doubted that if Chinnock had made an instrument which on trial possessed, or to a skilled expert exhibited features which promised to secure for it this capacity, the Holmes Company would at once have pushed it.

But of all these persons, only one was ever asked to try it. In the latter part of June or first part of July, 1878, Holmes sent Chinnock with his instrument to Roome, the expert, for a test (cross-ans. 39, p. 182). Concerning that test, Rooone says (cross-ans. 33–36, p. 181):—

"*Int.* 33. What was the character of the result at that time; or in other words, how distinctly or loudly was the speech transmitted?

"*Ans.* *Not very distinctly, but very loudly.*

"*Int.* 34. Could you or not at that time distinguish the speech transmitted through the instrument without hearing what the speaker said?

"*Ans.* I could.

"*Int.* 35. And did?

"*Ans.* And did.

"*Int.* 36. Was or not the result encouraging to Chinnock at that time?

"*Ans.* *He* seemed to be very much encouraged by it."

But the upshot was, that though Holmes had paid for the experiments so far and had bought the invention, or a large interest in it, no more tests or experiments were made, no new instrument constructed, and no steps were taken either to make further improvements or to patent what had been done (if anything), until after the parties had seen the Blake instrument introduced into commercial use. Mr. Holmes himself does not testify, we may fairly infer, because all he could say would be that the character of the results obtained satisfied him that Chinnock had accomplished nothing and was not in the way to accomplish anything.

It is further to be observed that there is no evidence whatever produced by Chinnock that his instrument is to-day capable of any better performance than that on which its owners dropped it in 1878 (*v.* p. 25 *infra*), nor that he has pursued the subject further since June, 1878, or has ever produced an instrument capable of practical use. His model, the instrument of June, 1878, is not a working instrument, but is strictly an experimenter's model: made up of old parts, cut, bored, altered; neither mounted, adapted, intended or ever used for anything more than private experiment in Chinnock's own hands.

Now, these acts of the parties prove two things: first, that Chinnock had not made any improvement in battery transmitters; and second, that such rude conceptions as he had were in fact dropped without further attempts at progress. This is not what the law considers diligence, as against a finished invention like Blake's.

The testimony of Chinnock himself, and of the young lady, his sister-in-law, as to the performance of the instrument, is under the circumstances not at all to be relied upon: first, because if the results were really good, the apparatus would certainly have been tried or used by others; and second, because, as it at most professed to be an improvement on existing instruments to better produce an old result, the question is not whether it transmitted at all, but whether it transmitted well as compared with other instruments. When Bell for the first time demonstrated, even though it had been

only by the transmission of a single word, that the method which he perfectly appreciated and explained was, as it has since been proved to be, both theoretically and practically, capable of doing what had never been done before, — viz., transmitting the *quality* of a sound, — he had made a success. But Chinnock, at a time when many thousand telephones were in use, reported that he had made an *improvement;* and whether he had or had not could only be shown by a comparison with what other instruments could accomplish. Now, a young lady of eighteen, with no knowledge whatever on the subject, can give no testimony worth hearing on *this* topic, especially as the instrument produced no effect on those who were capable. She says (cross-ans. 32, p. 144) : —

"I was not expected to know anything about the instruments; I was used simply as an assistant."

Her testimony is : —

Ans. 26, p. 143. "At times I could hear very distinctly, and other times it would not be so well."

Cross-Ans. 39, p. 145. "At times it has been very clear, and other times not so well."

"*Cross-Int.* 40. Has Mr. Chinnock at any time expressed himself entirely satisfied with the clearness of the speech?

"*Ans.* Yes; he seemed very much pleased *at times* with it.

"*Cross-Int.* 41. Do you remember whether or not, at any of the experiments, in April, 1878, the words spoken were all heard distinctly, or whether some words were heard distinctly, and others so indistinct as to be difficult to understand?

"*Ans.* At times everything could be heard that was said, and at other times it was not so well, — indistinct."

That is not an instrument which the public would be disposed to accept as an improvement on instruments so perfect that ten or fifteen thousand of them had been in general, practical commercial use for a year or more. Chinnock testifies as follows, with regard to all his experiments up to March, 1878 (p. 161) : —

"*Ans.* 27. Sometimes from the results obtained I would be exceedingly elated; at other times very much discouraged.

"*Int.* 28. Why was there such a difference in the results?

"*Ans.* At that time I did not thoroughly know; I attribute it now to crude apparatus."

But up to to-day he has never constructed any apparatus which works any better.

"*Int.* 67 (p. 168). State the quality of the speech transmitted by the instruments embodying your improvements, and of which you have testified as being in use in April and May, 1878.

"*Ans.* When I used carbon I could find very little fault; and when I operated without carbon, words were not so sharply defined, or in other words, it did not articulate as well; but it was sufficiently distinct to be readily understood by those I experimented with, even though the conversation was other than that ordinarily used in ordinary talk."

The application does not in any way indicate the use of carbon contacts; the only material named for that purpose is platinum.

This is the best that can come from the enthusiasm of the interested inventor; it does not prove an *improvement*.

It must also be observed as bearing upon the question of diligence, and showing the state of the art and the incentive to exertion, that Mr. Edison's carbon telephone, which is in effect a solid-electrode battery transmitter (though of a different class, mechanically considered, from those now in controversy), had been invented, constructed, put to use, and fully described as an operative instrument working between New York and Philadelphia, in the *Journal of the Telegraph* of April 16, 1878 (put in as an exhibit by Edison), a few days before Holmes authorized Bergmann to make all the apparatus Chinnock wanted; and the description there given of it was "every word spoken at one end of the line being clearly articulated at the other." We need not and we do not accept this as wholly correct, yet it was an instrument which professed to do this that Chinnock was to beat. Mr. Chinnock had seen some parts of Edison's telephones under construction at Bergmann's shop, and he testified (p. 172): —

"*Cross-Int.* 83. You speak of gaining a knowledge of Mr. Edison's telephones at Mr. Bergmann's: had you not, before April, 1878, read articles in the newspapers or scientific periodicals giving more or less description of the Edison telephone?

"*Ans.* I did.

"*Cross-Int.* 84. Is it not a fact that when you were experimenting on your telephone, you were trying to get something that would work and that would be different to the Edison telephone?

"*Ans.* During my experiments I was trying to get something better than anything I had ever heard of or seen."

We, however, have done what Chinnock did not venture to do, and have subjected his instrument to a careful test; and the result (which will be more particularly stated on p. 31 *infra*) is that it is a worthless and impracticable instrument, incapable of transmitting a continuous conversation.

It is impossible to deny the controlling effect of the intellectual element in inventors. It is that which distinguishes an improvement due to invention from an improvement due to mechanical skill. A patent which shows a very crude and imperfect apparatus may yet rank high among inventions, if the specification discloses to the community the importance of applying and the possibility of applying a new principle; for more skilful workmen and adapters may improve the instrument by following out the spirit of the improvement which the inventor has disclosed to them. This disclosure may be made by the express language of the specification; it may come from an instrument so constructed that when operated as directed, it will necessarily and normally set up that mode of operation which will disclose itself to the mind of an expert as clearly as if expressed in words. But suppose that the instrument be one which, in its ordinary use, sets up a particular mode of operation, and which is described by the inventor as intended and adapted to operate according to that mode, and as containing improvements especially fitted to that end: it cannot be doubted that a character is thus given to the invention which cannot be changed merely because, in the light of other men's later discoveries, the inventor perceives that under other circumstances and by special precautions it is possible to make the instrument set up a different mode of operation, and thereby accomplish a very desirable result.

Nor is it of any importance that the *result* of this new mode of operation is precisely that which the first man wished to attain, but which *his* mode of operation was inherently incapable of attaining; for patents are not based on desires, nor granted for results attained or unattained. In the narrowest sense, patents are for mechanical combinations of details; in the broadest and more controlling sense they are for the mode of operation embodied in an apparatus. The great patent cases, such as *Winans* v. *Denmead*, 15 How. 330, and the modern doctrines of reissue are based upon the recognition of the

philosophical truth that identity of invention, individualization of invention, rests in the mode in which the inventor intended and contemplated that the parts should co-operate; an intention to be drawn from his express language where he has made a "statement of invention," or from the ordinary and necessary operation of the apparatus when used as he contemplated.

In *Winans* v. *Denmead*, 15 How. 330, Judge CURTIS gave the following admirable definition of patentable invention: "Its substance is a new mode of operation, by means of which a new result is obtained. It is this new mode of operation which gives it the character of an invention and entitles it to a patent; and this new mode of operation is, in view of the patent law, the thing entitled to protection." The patentee may justly and legally say: "My improvement did not consist in a change of form, but in the new employment of principles or powers, in a new mode of operation, embodied in a form by means of which a new or better result is produced; this it is which constituted my invention."

It is also true that the difference between an instrument which operates in one mode and thereby produces one result, and an instrument which operates in another and thereby produces a different result, may be small when expressed in terms of mechanical structure; yet nevertheless, the passage from one to the other is the passage of the Rubicon, and the patent law delights to build upon it. If furthermore, with these two classes of instruments known, a subsequent inventor declares that his apparatus is an improvement on the one class, and that his improvement consists in devices which better enable his apparatus to operate according to the mode which characterizes that class, he has determined forever the character of his invention; and it does not change his position that he was so ignorant as to report that by the one mode of operation he hoped to accomplish what in fact the other mode of operation is alone capable to attain. After that, he may undoubtedly, like any one else, turn his attention in the other direction, and make an invention of the other class; but until he does, he cannot, either by reissue or any other kind of legerdemain, go back to his original conception of one thing, in order to cover the work of one who has afterwards achieved a successful machine, which is successful because its parts are inten-

tionally, inteligently and skilfully contrived to prevent the mode of operation of the first, and embody that of the second class.

In other words, if the two classes are distinct, an improvement in one class is a distinct invention from an improvement in the other.

These principles are decisive of Chinnock's claims.

Two Classes of Electrical Sound Producers — the Musical Telephone and the Speaking Telephone.

There are two distinct classes of instruments in which the human voice, acting upon a diaphragm, produces a sound at a distant station by means of electrical currents passing between them. The well-known instrument of one class — the Reis transmitter — differs very little in mechanical structure from the simplest typical form of the other class, — the solid contact variable pressure speaking telephone. But the Reis, known since 1863, though its inventor hoped to transmit speech by it, is incapable of so doing. In the cone form of this instrument (Prof. Cross, p. 221), the current normally passes from *d* to *g*, which are normally in contact. As the membrane *o* vibrates under the influence of the voice, its motion, exerted through the lever *c d*, pivoted at *e*, breaks the contact; and as soon as the retrocession of the diaphragm permits, the spring *n* restores the parts to their normal position of contact, ready for the next blow. It will be observed that when at rest contact is made at *c o*, and electrical contact at *d g*. The bulge of the diaphragm towards *c* pushes the lever out of the electrical contact *d g*, while maintaining the working contact *c o* by virtue of the stress of the spring *n*: when the diaphragm, in its excursion in the other direction, recedes so as to pass from its normal position in the direction towards *a*, its motion during that half of the excursion does not change the electrical conditions of the apparatus, because the contact of the electrodes at *d g* arrests the motion of the lever and breaks the motion, giving contact at *c o*.

In the box form (Cross, p. 222), a strip and point of platinum rests on the centre of the diaphragm, and there makes electrical contact. As the diaphragm vibrates up and down, this piece of platinum is caused to hop up and down, and by its momentum breaks contact and interrupts the current at each vibration.

This apparatus is incapable, and has always been recognized as

incapable, of transmitting speech, because the vibrations of the diaphragm operate to interrupt the current once at each excursion instead of continually controlling it without ever interrupting it.

The speaking telephone shown in Edison's application 141 has the feature of a diaphragm and a movable electrode on a lever arm, pushed one way by the vibration of the diaphragm and returned again by a spring.

That shown in his application 158 has a circuit passing through one electrode fastened to a horizontal diaphragm, and another resting on it chiefly by its weight. An unskilled observer, looking at the instruments at rest, would say that these features were the most prominent, and were found in the Reis. But the one will transmit speech, and the other will not. The difference is that the one operates to break, and by breaking the circuit; and the other operates to vary, and by varying the contact pressure without breaking the circuit. And each is perfect of its class, in so far as it is fitted to do that which characterizes its class, and is the antithesis of what characterizes the other.

Before proceeding further it will be well to consider what is the mode of operation by which alone a battery transmitter can transmit articulate speech.

To which Class does the Work of these respective Applicants belong?

Upon this question Chinnock's proof affords three pieces of evidence: the descriptions he gave to his own witnesses in the first half of 1878; the specification in interference, drawn in December, 1878; the behavior of the instrument itself.

The Essential Requisites of the Electric Speaking Telephone.

Instruments for the production of sound at a distance by means of electricity have been familiarly known for many years. One kind, known as the "harmonic" or musical telephone ("far-sounder"), is typified by the apparatus shown in Varley's English patent, No. 1,044, of April 8, 1870. A tuning fork vibrated at the transmitting station; each motion of its prong served to alternately make and break contact between two electrodes or ends of a circuit. When they made contact the current flowed; when the prong, in its vibration, moved away, the circuit was broken (or "opened") and the

current was interrupted: these successive interruptions, of course, occurred as often as the prong moved to and fro. At the other end of the line the circuit passed though the coils of an electro-magnet, opposite to the poles of which the prong of another tuning fork, or tuned spring reed, was placed. As often as the current passed, the core of the electro-magnet became magnetic or energized, and attracted the reed; and when the current stopped, the core lost its magnetism, and the reed, no longer attracted, flew back by its own elasticity. This to-and-fro motion occurred as often as the current was interrupted, and therefore the receiving fork vibrated the same number of times per second as the fork which served as interrupter. These fork vibrations, especially when the surface was broadened out, vibrated the surrounding air; and when these vibrations were of the rate which affects the ear as sound, — say over forty, and in practice over one hundred, times a second, — a sound was heard whose pitch corresponded to the rate or number of vibrations per second. And since the rate of the transmitting fork determined the rate of the distant fork (subject to certain mechanical limitations of power which were very important in the apparatus, but which need not here be considered), it followed that the transmitter determined the pitch of the sound which was produced at the receiver.

Now, this was not in any sense the transmission of sound. As both forks vibrated at the same rate, and as the commotion they produced in the air manifested itself to the senses as a sound whose pitch corresponded to the rate of vibration, it was quite true that the sound heard at one end was sensibly like the sound heard at the other; but equally at both ends the sound was the *result* of the operation of the apparatus, and not its cause. Indeed, the sound at the transmitting station was not even a desired result, — it was there a mere waste product; and if a silent current-interrupter was used (as has been done), or if the transmitter was *in vacuo*, so that no sound was produced there, still the apparatus operated in the same way and produced the same result at the receiving end.

But in the speaking telephone it is the sound itself at the transmitting station which, and which alone, actuates the apparatus. It stands motionless and silent; but when the sound waves produced in the air by the speaker's voice strike it, they set up the motion which produces the sound at the receiving station.

The harmonic telegraph, therefore, has not even a semblance of analogy to the speaking telephone.

The Reis instrument (shown and explained by Prof. Cross) is merely a modified harmonic telegraph. It differs from it in this, that the sound waves produced by a voice or sound-producing body at the transmitting station vibrate a membrane, — that is, throw it into a to-and-fro motion: but this to-and-fro motion is used just as the to-and-fro motion of the vibrating fork was used, to make and break an electrical circuit, — that is, to interrupt a current; and a suitable electro-magnetic arrangement at the receiving station caused these interruptions to produce a vibratory movement in some solid body, and thence in the air, the rapidity of which, and consequently the pitch of the sound produced by which, corresponded to the rapidity of the interruptions. Here the sound produced at the receiver had a pitch which corresponded to the pitch of that which acted upon the transmitter. This was the only resemblance.

But in the speaking telephone the sound produced at the receiving station corresponds to the sound uttered into the transmitter, not only in pitch, but in that mysterious something which constitutes articulation. Indeed, pitch, which is the only thing reproduced by the Reis, is, in the ordinary sense in which the word is used, quite unimportant in the speaking telephone; that is to say, if the spoken sentences were all reproduced in a higher or lower key, — changed from a man's voice to a woman's, — the change would not be of any particular consequence so long as the characteristic which constitutes articulation was preserved. Now, what constitutes articulation?

In this investigation, so far as we need to go, there is but one difficulty, and that is to bring the imagination to figure to itself these movements and changes, which we can neither see nor feel. Indeed, until within a very few years we had no proof of their existence beyond the fact that they served to explain observed phenomena, and we have not much beyond that now. We need to so familiarize the mind with the thought of them, that we can feel them (so to speak), reason about them, and mentally see them as readily as we do the material objects, which seem more comprehensible only because they are more accustomed.

Sounds differ from each other in several ways. The same person

may sound a syllable in different keys or pitches. He may also sound it with different degrees of loudness. But this is not all. If the same note be sounded with the same loudness by a human voice and by a violin and by a flute and by a trumpet, we still have no difficulty in distinguishing them. So we can distinguish between two voices speaking the same word with the same loudness and in the same key.

There is, then, in sound something besides pitch and loudness; this *tertium quid* is called character or "quality." In like manner, if the same voice speaks two different syllables in the same key they can be distinguished; and here again, that which distinguishes from each other the two syllables is quality or character.

As sound consists in vibrations or to-and-fro motions of the air particles, it follows, and indeed has long been known, that each peculiarity of sound has its corresponding peculiarity in the air vibration which constitutes it. The sound-producing motion of an air particle is always executed to and fro in a straight line radiating from the source of sound; but it is evident that this motion of an air particle may vary in several ways. It may vary in the extent of the path it passes over at each to-and-fro excursion. It may vary in the time it takes to pass over the path; that is, in the number of vibrations per second. But its motion is also susceptible of other variations. If its extent of path were fixed, and the time which it was to occupy were fixed, still it has liberty for other variations. It may pass from one end to the other at a uniform speed; it may move over part of its path with great speed and a part with less speed; it may go a certain distance on its path, then return part way and then go on again, and still reach the same extreme limit at the due instant. The variations thus possible, even when the limits of total path and total time are fixed, are simply infinite; and these variations constitute what is called the "character" or "form" of its vibration.

These physical movements have their corresponding effect on the ear.

Extent of path or amplitude of vibration means loudness of sound.

The time occupied in passing over the entire path, or rate of vibration per second (which is what is meant by "rate" in acoustics), means pitch of sound.

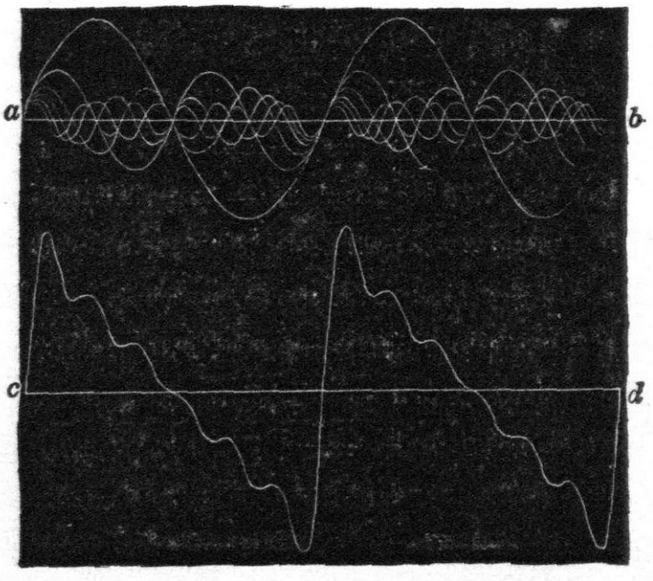
Character or *form* of vibration means character, quality or *timbre* of sound.

Now, character or quality is what constitutes articulation.

In the speaking telephone the sound waves produced by the voice strike the transmitter, and there transform themselves into electric waves or changes in electric current. These changes in the current produce in the receiver corresponding motions; or in other words, there retransform themselves into sound waves.

The motions or air vibrations produced at the receiver are caused by, and therefore correspond to, the electrical changes on the line wire; and if the sounds at the receiving end are to be the reproductions of those at the transmitting end in articulation, it is obviously necessary that the electrical changes shall follow the air vibrations due to the voice, not only in those features which correspond to loudness and to pitch, but in those features which constitute articulation, quality and *timbre*.

It is customary to represent vibrational movements by recurrent curves; and we can better make ourselves understood by referring to the curves in Prof. Cross's deposition (p. 211), there taken from "Mayer on Sound" (p. 153).



These curves represent a motion of one of the air particles whose vibration constitutes sound waves. The large curve on the line *a b* is a curve representing a "pure" sound, like that made by a perfect tuning fork mounted on a resonant box, and properly bowed. The curve *c d* approximately typifies one of the simple vowel sounds uttered by the voice. The distance from crest to crest, or the num-

ber of recurrences of these crests in a second, determines the pitch of the sound; and the vibration of the circuit-breaking diaphragm of the Reis when spoken to will determine the character of the variations of the electrical current in this particular, but in nothing else. The height of this crest in the air vibrations signifies the amplitude or the loudness of the sound; in the electrical variations it signifies the current strength. But in the Reis the apparatus *controls* only two conditions of strength: when contact is closed, the full strength of the battery is on the line; when contact is broken, no battery is on the line. The apparatus can choose the maximum or the minimum, but it has no control over anything between the two.

Now, the curiously curved line which runs from crest to crest differs for every articulate sound, and the determination of the word means the determination of the character of this line.

To state it in the graphic or geometrical form, the Reis can fix the point at which each crest shall fall; the height is fixed with that apparatus by the strength of battery used, the distance apart by the frequency of vibration, but the Reis transmitter is utterly unable to control the *character* of the line which connects these two points. And it is the character of this line (that is, the *form* of vibration which it represents) which signifies (or constitutes) articulation.

The Reis fixes the position of each crest, as we have seen, but neither it nor any circuit breaker can do any more. At each vibration it makes contact and lets on the current, so to speak, for one instant; but the moment it has broken contact, the vibrating diaphragm ceases to control the electrical condition of the line. The *character* of its movement during the period of non-control (that is, until it again makes contact) exercises no influence over the *character* of the current variations, and consequently no control over the magnetic variations of the core of the receiver. In virtue of what is known as magnetic inertia and sluggishness, the core does not instantly become magnetized to its full extent as soon as the current flows, nor does it instantly become entirely demagnetized when the current stops; the time required for this is inappreciable by ordinary measurements, but electricity and acoustics take note of it as of great importance. Now, this rise and fall of magnetic strength in the receiver, which is what directly produces the sound there, varies with

each different magnet under the influence of a rapidly intermitted current. The curve which represents it — *i. e.*, the character of the line from one crest to the next of the magnetic variations (the essential thing to be controlled, because it is that which produces the sound there heard) — not only is not controlled by the motion of the transmitting diaphragm, but it is controlled by the size, proportion, material and other physical characteristics of the particular apparatus used.

The *character* or *form* of these variations, using those terms in their technical sense, — that is, the character of the line between the crests, — is what, as we have seen, determines the *character*, *quality*, *timbre* or *articulation* of the sound produced by the apparatus; with the Reis circuit breaker, therefore, the sound produced at the receiving end is in its *quality* controlled by the physical attributes of the apparatus, and not by the motion given to the diaphragm by the sound waves.

It will be noticed that with the Reis, the only effect of the sound at the transmitting station is to move the diaphragm a certain number of times per second. If the sound is of the pitch desired, it is of no consequence whether it be made by the voice or by a musical instrument; and if made by the voice, the result at the receiving end is the same whatever vowel or syllable be sung into the transmitter.

To make a speaking telephone, therefore, it is necessary that the apparatus shall be so contrived that every motion which the diaphragm takes up from the sound waves shall, at every point of its path, control the current, and compel it to take all those variations, intermediate between its maximum and its minimum, which constitute form, quality, character, in the sense we have explained it.

The microphone class of speaking telephone transmitters, to which Mr. Blake's instrument belongs, must embody this principle, and as a means of carrying it into effect depend on what are sometimes called the electrical properties of a bad joint. If a circuit, say of wire, be cut and the two ends be placed in contact, the current will pass, but with more difficulty than before; if the parts be pressed together lightly the electrical resistance is great, and the current, by Ohm's law,

$$\text{Current strength} = \frac{\text{electro-motive force}}{\text{resistance of circuit}}$$

will be enfeebled; if they are pressed more firmly together the current becomes stronger. Speaking telephones constructed on this principle consist of one electrode connected with the diaphragm and partaking of its motions, and another electrode, which we may call the anvil electrode, placed in contact with the first so as to offer considerable resistance to the motion. The movement of the one and the mechanical or molar resistance to motion offered by the other produce variations in pressure between them, and these variations in pressure correspond in "character" or "form" to the vibrational movements of the diaphragm to which they are due; and thus *every part* of the motion of the diaphragm impresses a corresponding character on the current of a circuit which passes through the contact. Expressed in ordinary language, the capacity of these instruments to transmit speech, and their distinction from the Reis, is that the vibrating diaphragm never breaks contact, but in every part of its motion controls the current.

Instruments of this class had been invented and constructed before either Mr. Blake or Mr. Chinnock began. The applications of Mr. Berliner and Mr. Edison had been in the Office long before. Those two gentlemen (the question of priority is pending between them) had shown this true mode of operation; the only problem was to improve the mechanical construction of the instruments so that the variations of pressure should *truly* correspond to the motions of the diaphragm, and that the two electrodes should never part contact.

Our position is that this is what Mr. Blake did, but that Mr. Chinnock's work was upon an entirely different class of apparatus and in a different direction.

The extreme minuteness of the variations, which are thus essential, must not be lost sight of. In the case of a woman's voice, the crests of Prof. Mayer's curve would recur about five hundred times a second. His curve is rude and imperfect compared with the delicacy of nature, and the range of variation is infinite. It is obvious, therefore, that a loss of control over the current for probably the $\frac{1}{2000}$ part of a second would materially alter the character of the curve and of the sound produced. The rude accuracy of the best mechanical work is nothing compared to the truthfulness required in

this apparatus; for it must truthfully respond to the utmost delicacy of the sound waves which operate it. It was in appreciation of this requirement that Sir William Thomson, having used Bell's telephone at the Centennial, said to the British Association that it realized "the *mathematical conception*, that if electricity is to convey all the delicacies of quality which distinguish articulate speech, the strength of the current must vary continuously, and as nearly as may be in simple proportion to the velocity of a particle of air engaged in constituting the sound."

Of course an instrument may fail to transmit the sounds with perfect integrity, and yet may do it so well that more or less of them may now and then be unintelligible; it may be so poorly constructed that now and then, for a few instants, the electrodes will remain in contact, and act as a microphone, though habitually they break. But it is obvious that an inventor who introduces a modification in order more surely to make them break contact is not making nor improving a speaking telephone, nor anticipating any one who introduces modifications which are intended to, and in fact do prevent a break.

What constitutes in Law Individuality, Identity and Difference in Inventions.

We will first state the leading authorities and then apply them to the case at bar.

Winans v. *Denmead*, 15 How. 330. The Court, by Judge CURTIS, gave the following definition of patentable invention: "Its substance is a new mode of operation, by means of which a new result is obtained. It is this new mode of operation which gives it the character of an invention, and entitles it to a patent; and this new mode of operation is, in view of the patent law, the thing entitled to protection." The Court remarked that the patentee might justly and legally say: "My improvement did not consist in a change of form, but in the new employment of principles and powers; in a new mode of operation, embodied in a form by means of which a new or better result is produced. This it is which constitutes my invention."

Smith v. *Nichols*, 21 Wall. 118. "A patentable invention is a

mental result. . . . The machine, process or product is but its material reflex and embodiment. A new idea may be engrafted upon an old invention, be distinct from the conception which preceded it, and be an improvement. In such case it is patentable. . . . But a mere carrying forward of the original thought . . . is not such invention as will sustain a patent."

In this case the Court was inquiring whether two things which were different commercially were different in the sense of the patent law. They were looking for the mark which distinguishes things in respect of the quality of invention. They found it in the *mental* result; in one idea as distinguished from another, one conception from another, one thought from another. Measured by that standard, they found that Smith had made no invention.

In the cases that follow they applied the same test, and expressed in various forms, they still rested the distinction, not upon a mere physical difference, but upon a difference in the mental conception which the thing embodied, — the same distinguishing mark which Judge Curtis, in more homely language, called "mode of operation": and so long as invention is distinguished from mechanical skill in its essence (though not always distinguishable in its results), so long the conception will control rather than the form in which it is embodied; or in the words of the statute, the first thing is "the principle," and the subordinate thing is "the mode in which he has contemplated the application thereof."

Cole v. *Loud*, Comr's Dec. 1870, p. 5. FISHER, C. "Invention, within the meaning of the patent law, is the conception of some new and useful thing, and the embodiment of that conception in a practicable form. I think it cannot be doubted that this definition must include an intelligent conception. It must require that he shall know that he has found something, and be aware, at least, that it is capable of use."

Ex parte Holt, Comr.'s Dec. 1874, p. 15. THACHER, C. "Now, it is not merely the bringing of elements together for the first time that is patentable. The new grouping of devices must be accompanied by evidence of invention, and must produce a new result."

Bischoff v. *Wethered*, 9 Wall. 812. The Court (opinion by BRADLEY, J.) considered how a patent should be read, and pointed out a very philosophical and just distinction between the terms used and the thing signified; and the thing signified was not the physical parts of the apparatus, but the idea which they embodied. "The whole subject matter of a patent is an *embodied conception* outside the patent itself, which, to the mind of those expert in the art, stands out in clear and distinct relief, whilst it is often unperceived or but dimly perceived by the uninitiated." One of the English cases there approved (found in "Curtis on Patents," Sect. 446, last edition) states the question to be "whether the two specifications that are brought into comparison do or do not indicate the same external matter." Another of those cases says that if the language of the two specifications be the same *verbatim*, yet it does not follow that the inventions described are the same, unless the words of art found in one, in fact, had, at its date, the same signification which the same words had when they were used forty years later in the other specification. For, as the Supreme Court said in *Bischoff* v. *Wethered*, "it is not the construction of the instrument, but the *character of the thing invented*, which is sought in questions of identity and diversity of inventions"; and since the thing invented is "an embodied conception," it cannot be doubted that it is the *conception* which gives to it that "character" which is sought in questions of identity and diversity of inventions.

Tucker v. *Spalding*, 13 Wall. 453. Opinion by MILLER, J. The Court cited the foregoing case with approval, and made an application of it in a special direction. The question was whether the patentee had merely made a double use of a device shown by the old patent of Newton. The Court said that the question was, what the structure *and action* of Newton's device suggested to the mind of an ordinarily skilful mechanic. "The Court, in rejecting the patent of Newton, seems to have been mainly governed by the use which was claimed for it, and also that no mention is made of its adaptability as a saw. But if what it actually did is in its nature the same as sawing, and its structure and *action* suggested to the mind of an ordinarily skilful mechanic this double use to which it

could be adapted without material change, then such adaptation to the new use is not a new invention, and is not patentable."

Draper v. *Potomska Mills*, 13 O. G. 276 (1878). SHEPLEY, J. In considering the attempt to date an invention back to its first conception, the Court determined what it was which constituted a "conception" in the sense of the patent law, and declared it to be "a matured and perfected invention in the mind of the inventor, requiring only an embodiment in an operative spindle and bobbin to entitle him to a patent."

Stevens v. *Putnam*, 18 O. G. 521. MARBLE, C. The conception of the invention means the union in the mind of the inventor of the principle or discovery with the means of its embodiment,—a well-defined idea of something which might rightfully constitute the subject of a patent. Citing from the opinion of STORY, J., in *R. R.* v. *Stimpson*, 14 Pet. 488, the remark, "Invention itself is an intellectual process or operation," and quoting from *Everett* v. *Brick*.

Everett v. *Brick*, Comr.'s Dec. 1871, p. 89. "The point of time at which invention, in such sense as to merit the protection of law, dates, is . . . when the thought or conception is practically complete, . . . when the inventor is ready to instruct the mechanic in relation to putting it into working form."

Forsyth v. *Clapp*, 1 Holmes. SHEPLEY, J. The Court, in considering whether the invention described in a reissue was the same as that described in an original patent, said that it was not enough that the parts enumerated in the reissue could be found in the original; and proceeded to state that even in that case the contrast was between "what the patentee really invented" and "some contrivance not within the knowledge or contemplation of the patentee, and for that reason not embraced in the claims of the original patent."

Marsh v. *Dorsey Mfg. Co.*, 6 Fish. 562, 5 O. G. 398. WOODRUFF, J. A change of location is not patentable as such; but "where such change of location brings into existence a new combination of devices, operating by reason of such new combination to produce a new and useful result, such new combination is patentable."

Ransom v. *Mayor of New York*, 1 Fish. 265. HALL, J. If the alleged prior inventors put together certain parts which, even as

they used them, did have a mode of operation like that afterwards embodied by the patentee in his apparatus, yet if they neither perceived this nor the result which could be obtained by it, they are not the inventors.

Hussey v. *Bradley*, 2 Fish. 360, 5 Blatch. 134. NELSON and HALL, JJ. The patentee claimed a certain arrangement of cutter blades on a bar. A prior inventor had, in fact, arranged some blades in the same way, but did not adopt that mode as the rule of arrangement, nor discover nor appreciate the fact of the advantage of this particular mode. This does not destroy the patent.

Union Sugar Refinery v. *Matthiessen*, 2 Fish. 602, 2 Cliff. 639. CLIFFORD, J. Apparent identity or dissimilarity in shape or form amounts to nothing; the question turns upon the *mode of operation, or the way the parts work.*

Swain Turbine Co. v. *Ladd*, 11 O. G. 153 (1877). SHEPLEY, J. In turbine wheels "form is material, substantial and functional, and very slight changes of form and proportion involve functional changes of great importance. Slight modifications and deviations from any prescribed operative forms and proportions may destroy the usefulness or *put an end to the identity of the device*, or on the other hand may effect new and different and better results."

Mowry v. *Whitney*, 14 Wall. 620. It was contended that the manipulation described in the patent would spoil the wheel instead of improving it, and it was certain than an exposure of the car wheel to the heat named as the maximum would ruin the wheel. But the specification indicated that the wheel was to be heated above the point where serious strains began in the process of cooling, and yet not so high as to destroy the chill of the rim: and the Court held that with this declaration of the desired result and of the intended mode of operation, the skill of the operator would be directed aright by the specification; that the inventor might leave much to the skill of the operators, *if he led them in the right direction.*

Parkhurst v. *Kinsman*, 1 Blatch. 488. NELSON, J. "The right of the inventor does not depend upon the question whether the machine is more or less perfect, or whether slight modifications in the arrangement of the machinery, or in the finish of the parts composing it, may or may not better accomplish the end sought to be

attained; but upon the question whether the machinery constructed as described in the patent will or will not accomplish the end practically and usefully *in the way pointed out*. . . . Such perfecting is but the skill of the mechanic, not the geinus of the inventor."

Russell v. *Dodge*, 93 U. S. 460. The original patent was for a process of treating bark-tanned sheepskin by means of a compound in which heated fat liquor was an essential ingredient. The reissue was for a process of treating the same skin by means of fat liquor or of a compound of which fat liquor was an essential ingredient. The reissue in terms covered and was intended to cover the use of the liquor when cold, though it stated that it was desirable that it should be heated and that the other ingredients named in the original patent should be used. It was true, in point of fact, that the result attained by the old process was obtained from the character of the liquor, and that the temperature, though useful, was not essential. But the inventor did not at any time contribute this knowledge to the useful arts, for the reason that it did not accord with what he believed to be and stated to others to be the mode of operation of his invention. The reissue was held void because it set forth a different invention. The Court said: "The change made in the old specification by eliminating the necessity of using the fat liquor in a heated condition, and making in the new specification its use in that condition a mere matter of convenience, and the insertion of an independent claim for the use of fat liquor in the treatment of leather generally, operated to enlarge the character and scope of the invention. The evident object of the patentee in seeking a reissue was not to correct any defects in a specification or claim, but to change both, and thus obtain, in fact, a patent for *a different invention*. This result the law, as we have seen, does not permit."

Ex parte Collins, Comr.'s Dec. 1870, p. 82. FISHER, C. The one holder "is so elastic as not to fracture the expanding glass while clinging to it; the other does not fracture the glass 'in consequence of being kept free' from it." One device was intended to operate by elasticity, and the other not, though it possessed some theoretical elasticity. The inventions are different.

It is easy to see the application of these authorities to the case at bar. The "conception" and "well-defined idea," the "principle" and the "thought," which Chinnock sought to embody in his apparatus in the first half of 1878, was that of a circuit breaker, and not of a variable-pressure apparatus or microphone. That was what he disclosed to Newbury and Roome; that was the mode of operation which was habitually and normally set up in his model.

The skilled mechanic of *Parkhurst* v. *Kinsman* (cited *supra*), striving to perfect the parts so as to work better "in the way pointed out," if he had followed Chinnock, would have been led away from Blake's result, and would have wasted his time in the fruitless attempt to make a circuit breaker transmit speech. If the world had had nothing but Chinnock's apparatus, and the information he communicated to Newbury and Roome, it would never have got the articulating microphone till some one else had invented it. The verbal communication did not describe it, and the ordinary operation of the apparatus did not indicate it to an ordinary skilled workman.

Observe, the question is not whether a patent which has actually introduced microphones to the public can be saved, but whether the Holmes Burglar Alarm Telegraph Company can control Blake's instrument, which operates upon a principle which their applicant never conceived of.

It would not help the case if every part of Chinnock's model were so like the corresponding part of Blake's microphone that mechanical skill could not tell the difference. If the pieces were shaken up in a basket, they would be placed together in the sense in which claims are sometimes drawn. But no invention is made until the inventor has so placed them together that, when manipulated as directed, they will set up a certain operation *inter se;* and if the fact of invention depends upon the fact of *operation*, the character of the invention depends upon the character of the operation.

The difference between an instrument of the Blake class and an instrument of the Chinnock class is, in the language of the Swain wheel case, material, substantial and functional; material and substantial *because* functional. Even if an issue could be framed in language which would fit both because it described neither, the fact would not

be changed. A claim or a paragraph which professes to formulate an invention cannot be read alone; if it could, the descriptive part of the specification would be needless. Its office is to call attention to a particular part of that which is described elsewhere, and a claim is to be read with reference to the whole schedule, and with the words "substantially as described" written in, by the law. To recur to *Bischoff* v. *Wethered*, p. 25, *supra*, the external matter, the embodied conception, which to an expert in the art stands out clear and distinct from Blake's specification, is not the conception which was disclosed by the only reported descriptions given by Chinnock before Blake's transmitter had excited his wonder. And since this is so, the issue, which is obviously intended to describe the Blake, is not met by anything Chinnock had ever conceived of. This is especially true of Case 2, which is in the language of Blake's claim, omitting the words "substantially as described," — words which the law always keeps there, because the canons of interpretation require them to be kept there. It is true of the first issue of Case 3, which is in the language of Edison's claim, with the same words omitted. It is equally true of the second issue of Case 3, because the purely arbitrary word "circuit-governor" has no significance except as a sign-post to something elsewhere described.

There is no fallacy known to logicians which has brought so much discredit upon the patent law as the fallacy of equivocation, or that form of "ambiguous middle" which consists in the use of an equivocal middle term. A certain form of words is correctly applicable to one apparatus, and it is correctly applicable to another; and so the two are the same. But not if the common phrase signifies one thing in one specification and another thing in another; for then the middle term, or standard, ceases to be a standard. It was this verbal logic which is at the bottom of so many reissue claims that Judge Bradley's keen mind touched in *Bischoff* v. *Wethered*.

We do not mean to overlook the remark of the Court in *Tucker* v. *Spaulding*, 13 Wall. 453. If breaking the circuit, which is what the apparatus actually did, was the same in its nature as the variation of current by which the microphone produces its results, and if its structure and *action* suggested the speaking microphone to the mind of an ordinarily skilful mechanic, then the case would not be

what it is now. But even if this were so, Chinnock would have to deal with the further fact that he did not leave its structure and action to make their own suggestions, but accompanied them with a statement of the intellectual part of his invention.

Moreover, the two modes of operation do not coexist at any one time. In the process described by the original fat-liquor patent, the fat liquor and the heat were both present, and it might be well said that the patentee did not vary the contribution he had made to the useful arts, if in the light of better scientific knowledge he told the community to merely dispense with that part of his process which was superfluous. But even there the Court held the inventions to be different, and not merely differently stated. But here Chinnock's conception was of a mode of operation which included everything that was fatal to the transmission of speech, while it necessarily excluded, *ipso facto*, everything which made such transmission possible. One hundred dollars may buy a horse and one hundred dollars may buy a wagon, but one hundred dollars will not buy both; and if a man has only a one-hundred-dollar bill in his pocket, every step he takes toward the carriage factory disables him from getting the horse. It certainly does not change the character of his invention that his apparatus did not embody his ideas quite so perfectly as he intended, and as he continued to intend, until he had seen Blake's work in successful commercial use. It is true that a man by a lucky accident may stumble on an invention; but if when he stumbles on a nugget of gold he passes it by and goes on looking for a piece of brass, the next man who comes along and finds the gold and picks it up may claim title as the first finder.

The Mode of Operation proved by Chinnock.

Mr. Chinnock's first proof is his sketch Exhibit 3, made about December, 1877 (ans. 18, p. 158). That sketch shows that the circuit is broken in the transmitter between the two electrodes.

In his sixtieth answer (p. 167), he names the persons to whom he described his alleged inventions, but only two of them pretend to give any intelligible statement of its mode of operation. Fortunately those two — Messrs. Newbury and Roome — are both skilled men,

in the employ of the Holmes Company; and one of them, Mr. Roome, was the expert employed by Mr. Holmes to test this apparatus.

Mr. Newbury, having first been present when the bargain between Chinnock and Holmes was made (ans. 6, p. 149), met Chinnock a few weeks afterwards at Bergmann's shop, and there received a description of the transmitter from Chinnock (ans. 7, 8, p. 149). He testified (p. 151): —

"*Int.* 16. Did or not Mr. Chinnock show you one of his transmitters when he gave you this description?

"*Ans.* He did not, as I understood what he meant without showing me the instrument.

"*Int.* 17. Will you please state, as fully as you can, all that he said on that occasion about this transmitter?

"*Ans.* After describing it to me, he said the action of the weight tended, when put in motion by the action of the diaphragm, to keep the circuit broken longer than it otherwise would be; and that by so keeping it broken longer, the action upon the receiver would be more distinct, and would talk longer and for longer distances. He thought with it he would be able to talk from New York to San Francisco, Cal."

"*Int.* 20. Have you or not, since the referred-to description given by Mr. Chinnock to you of his transmitter, had any conversation with him concerning the same; and if yea, during what period of time?

"*Ans.* I have, from that day to the present."

So there can be no doubt but that the description thus given accords in spirit with all Chinnock's subsequent talk with this witness, who says (ans. 27, p. 153): —

"I was requested by Mr. Edwin Holmes, the treasurer of said company, to aid in conducting these interferences in behalf of said company, and I have done so."

Mr. H. C. Roome testified, p. 180: —

Ans. 17. "When I went into Mr. Bergmann's shop I saw this, a clock work" [some of his own, by which he fixes the dates the last week in April, 1878] "which had been altered, laying upon the work-bench beside a transmitter. I suspected that this transmitter belonged to Mr. Chinnock, as he had been very secret about his improvement, and had not shown it to me. I picked it up and looked at it. Mr. Chinnock came in, saw me looking at it, and then explained the principle upon which it worked to me."

"*Int.* 22. What did Mr. Chinnock describe as the principle on which the transmitter which you saw at Bergmann's shop worked?

"*Ans.* He described and showed to me an ordinary transmitter mouthpiece, to which was affixed a diaphragm having upon its centre soldered a platinum wire; upon the back of this mouthpiece was placed a ring of insulating material, to which was affixed a spring, carrying upon its lower extremity a weight, which impinged against the platinum wire. When the mouthpiece was spoken into, the sound waves, throwing the diaphragm into vibration, threw off the weight-loaded spring from the platinum wire."

This was Exhibit 4. He afterwards, in July, 1878, saw the Patent Office model, but he expressly testifies that the two were similar (ans. 23–29, p. 181).

These are the only reports of descriptions given by Mr. Chinnock at the time of the mode of operation of his instrument.

Now, it is too clear to require remark that this apparatus, which "threw off" the weighted electrode from the diaphragm electrode, and "kept the circuit broken longer than it otherwise would be," had the mode of operation of the Reis circuit breaker, and not of a circuit-preserving transmitter; and Prof. Cross testifies, as indeed is obvious, that in so far as an apparatus operates as Newbury and Roome describe, it belongs to the Reis class and not to the Blake class. (Cross-ans. 11–16, pp. 224–226.)

It is a circumstance of considerable weight that before Chinnock took his testimony he was officially informed on the record that he must meet the objection that such an instrument as his was merely a "musical telephone," — *i. e.*, a circuit breaker, — and not a speaking telephone. Mr. Edison's preliminary statement (record, p. v) expressly states this.

The Blake Specification.

Mr. Blake's specification puts forward prominently that in his instrument the variations of current are produced by *variations in pressure;* that the outer (or anvil) electrode "is so weighted that by its inertia it will offer a resistance to the slight and quick motions of the diaphragm, and will give a varying pressure between the electrodes and a consequent change in the resistance of the circuit" (p. xxii). He then describes one device introduced in order "*to secure contact between the electrodes.*" Then, having described the features involved in this interference, — to wit, his peculiar method of supporting the electrodes, — he says: —

"This method of supporting the electrode *insures its contact with the other electrode* under some circumstances when otherwise they would be liable to be separated and the circuit broken."

He then describes each spring, saying that the weighted spring *d* "must be stronger than the spring *c*, which supports the intermediate electrode *e*, and from its greater strength it tends to keep the electrode *e* in contact with the diaphragm. . . . The weight must be proportioned to the stiffness of the spring, a stiff spring requiring a heavier weight than a weak one." Then, describing the special advantages of his intermediate spring pressing against the other, he says: —

"It should be observed that an additional improvement is gained by supporting that electrode on an independent spring, which keeps it in contact with the electrode *e*, for it not unfrequently happens when the intermediate electrode is attached directly to the diaphragm, that a too rapid vibration of the diaphragm or some other disturbance in its vibrations will throw the outer electrode out of contact with the intermediate electrode, and thus break the circuit; *but in my construction*, such irregular vibrations of the diaphragm will separate the diaphragm from the intermediate electrode *e*, rather than separate the two electrodes from each other, *and the circuit will not be broken*."

There can be no doubt here that the mode of operation, and the whole character and purpose of the special construction, lay in preserving the contact of the electrodes unbroken; and the success of the instrument shows that this object was attained.

The Chinnock Specification.

Mr. Chinnock begins by saying (and he repeats this frequently) that his object is to produce sounds "with greater volume" than heretofore. We have already shown that this is precisely what a circuit breaker will do as compared with a speaking telephone. The novelty claimed by him is the device which he calls a *circuit governor*, and which forms the subject of all the interferences; namely, his movable weight. He characterizes this in an amendment introduced Feb. 25, 1879, and which must therefore be considered as the expression of his most serious and deliberate afterthought. He says (p. xv): —

"My invention consists in the combination, etc., of, etc., and a circuit governor . . . weighted in such a manner that it will, when acted upon by the diaphragm, acquire a momentum, and move or swing aside . . . *and hence will keep the circuit broken accordingly.*"

Again he describes it on p. xvi: —

"A pendulous circuit closer, weighted near the free end . . . capable of being swung aside by the movements of the diaphragm aforesaid to *break the said division* of the electric circuit more or less."

P. xvii: "Strong sound waves swing the circuit governor backward sufficiently to entirely remove it from contact with the screw J. . . . The advantage of providing the circuit governor with a weight is that it will, when actuated by the diaphragm, acquire a momentum whereby it will be retarded in returning, and *hence will leave the* division of the *current* which it controls partially or wholly *open longer than otherwise.*"

Stating a different but equivalent way of arranging the electrical connections of the same instrument, he says (p. xviii): —

"It is obvious that instead of connecting one pole of the division E of the electric circuit with the screw J, it may be connected with the circuit governor O, and then the said division of *the electric circuit may be* connected and *broken* by the action of the pin M in connection with the said circuit governor."

No one can doubt that he was describing a circuit breaker, and that the invention he indicated was the invention of a device which caused the circuit to be broken more certainly and for a longer time.

It is true that both Blake and Chinnock have a weight carried on the end of a spring, but everything depends on the proportions and arrangements of the parts. Mr. Blake's model is one of his actual working instruments, such as are in universal use, and his drawing of it therefore gives good proportions; and he says that in varying the parts, the increase in weight of the inertia mass should accompany increase in the stiffness of the springs; and his specification shows to the mechanic the essential requisite which must control all changes. Mr. Chinnock, too, shows his only instrument in his model and drawing. Neither state the size of the parts in specific words, but each shows in a sufficient manner, and in the manner usual in this class of instruments, what the proportions must be, especially in two descriptive sentences which characterize their whole work. We quote from the specifications: —

Blake, p. xxii: —

"The other electrode . . . is so weighted that by its *inertia* it will offer a resistance to the slight and quick motion of the diaphragm which will give a varying pressure between the electrodes."

P. xxiii: —

"This method of supporting the electrode *insures its contact* with the other electrode."

P. xxv: —

"By reason of the *inertia* of the weight, the tendency of the spring to follow the vibrations of the diaphragm is checked."

Chinnock, p. xv: —

"A circuit governor . . . weighted in such a manner that it will, when acted upon by the diaphragm, acquire a *momentum* and move or swing aside . . . and hence will keep the circuit broken accordingly."

P. xvi: —

"A pendulous circuit closer capable of being *swung aside* by the movements of the diaphragm *to break* the . . . electric current."

P. xvii: —

"The advantage of providing the circuit governor with a weight is that it will, when actuated by the diaphragm, acquire a *momentum* whereby it will be retarded in returning."

It will also be noticed that Chinnock everywhere speaks of the weight acting by its *momentum*, whereas Blake speaks of it as acting by its *inertia*. Now, without discussing problems of abstruse science, these words impress upon everybody precisely the meaning which they were intended to convey: that is, in one case that the object acted upon moves further than the thing which pushes it, and after the latter has ceased to act, and so they part company; and in the other, that the weight acted upon resists the impulse and produces between the two bodies a change in pressure, but no parting. A cannon ball fired from a gun, or a ballistic pendulum, is an example of momentum, while an anvil or the suspended sand-bag of the boxing-school is an example of the other. The Chinnock arranges and employs a weight to store up force from which it shall derive motion to break the circuit. The Blake arranges and employs a mass to absorb the force, so as to vary the resistance without breaking the circuit.

It is true that the Chinnock specification speaks once or twice of the circuit governor as operating to "partially or wholly break the circuit," or to "break the circuit more or less." It is not easy to

understand what is meant by this language, unless it refers to the longer or shorter time the circuit is broken; but whatever it may mean, it, even taken by itself, shows an instrument intentionally so constructed that in its normal action it constantly, if not invariably, breaks the circuit.

The Proof by the Instruments themselves.

Prof. Cross has carefully and in a long series of experiments tried the Chinnock instrument, and these experiments develop this result. He says that the Chinnock instrument is well adapted to break the circuit as described by Newbury and Roome, while the Blake will not break the current under any usage to which it is ordinarily subjected. Though the distinction between the two classes is generic in its character, yet it is true that very slight changes will turn an instrument from one to the other, and some instruments which belong to one class can be so manipulated that they will occasionally and abnormally and for an instant produce in a fragmentary way the results which belong to the other class. Thus the Reis transmitter can, without change of structure, be altered by slightly changing the position of its parts, and then, when subjected to a manipulation which Reis did not contemplate, it will set up a new mode of operation in the hands of a person specially trained for this work, and can thereby transmit a few words. But that does not tend to show that Reis invented a speaking telephone; we know that he did not. Mr. Cross, instructed by the knowledge which he to-day possesses, has done this, and he has very well shown that the instrument thus modified and used ceases to be a Reis transmitter; for the change, though slight, is sufficient to set up a new mode of operation and produce a new result; this mode of operation was not known and this result not attained by Reis.

In the same way the Chinnock instrument described in the application will not transmit a consecutive sentence; yet upon making in it the same kind of change that he made in the Reis, Prof. Cross succeeded in transmitting some words, when using it under the most favorable conditions.

In *Stewart* v. *Mahoney*, decided Jan. 28, 1879, U. S. Circuit Court, District of Massachusetts, LOWELL, J., said: "I have exam-

ined the evidence and the arguments with care, and I am of opinion that there was both novelty and utility in the subject of the first claim, and that it has been infringed. Many chairs had been made that resembled the plaintiff's in many particulars, and which might easily have been so modified as to embody his invention, but they do not appear to have been so modified before his time.

"The question of novelty, including in that word the discovery or invention which will be sufficient to support a patent, is often a very difficult one to decide. Invention often involves a new result, first thought of by the patentee; and in such cases, the fact that the mechanical changes he has made are not difficult is often unimportant. The cases in which invention is wanting are usually those in which the result is old in kind, and the change of means is obvious, or has been used in analogous machines or articles, and then the smallness of the change is very likely to be decisive against the patent."

Tests of the Instruments by Prof. Cross.

The instrument described in the application of Chinnock has the weight suspended by a *flexible* support, a "flexible metallic strip." A strip of foil will answer this description as well as a watch spring, and in fact better, since the weight is habitually described as *pendulous*. In Blake's specification, the support is described as a spring, the stiffness of which is to be proportioned to the weight it carries. In all three issues, a principal feature is the weight. The experiments of Prof. Cross were as follows: —

1. The Chinnock apparatus, with the weight suspended by "a flexible metallic strip" of foil, the whole held perpendicular, as Chinnock directed, would not transmit a word. When tipped very considerably out of the perpendicular, detached words could be transmitted by using great care and skill to so speak as *not* to vibrate the diaphragm sufficiently to throw the weight aside or break the circuit.

2. Inserting a stiff spring to carry the weight in place of the foil, screwing it up tight and speaking carefully, several consecutive words can be transmitted without breaking the circuit; but whenever a break occurs, articulation ceases.

3. Using the spring without any weight, and with the same treatment rather better results are obtained than with the weight, because it does not break so much.

4. Under no circumstances was the instrument as effective as the Bell magneto telephone in general use before Chinnock began.

Thus it is clear that Chinnock's statement to Roome is correct; viz., that in his instrument the weight normally operated to break the circuit, and if at any instant it did not do so, it was due to the presence of the spring, which is not described in his specification, and which Chinnock has been adjudged not to be the first inventor of.

On the other hand, with the Blake, it is proved by Prof. Cross's experiments, —

1. That it does not break the circuit under any ordinary usage.

2. That as arranged and combined by Blake, the weight is of importance; because, when it is removed, the efficiency of the instrument is very much impaired.

We do not quote from Mr. Cross's deposition, because the examiner should read the whole.

Now, it may be true that if and when any one had disclosed to the world that a new type of construction would bring into play a new mode of operation which opened the road to a great line of improvements, even such poor practical result as these Chinnock instruments have might save the patent; yet this cannot entitle Chinnock, as against the clear conception and perfect instrument of Blake, to date back to a time when he had no conception whatever of the mode of operation he seeks to cover, and was working on a different line, in which he did not attain and never can attain any practical success, or make instruments as good as those in common use before his time.

The extracts already given from Mr. Blake's specification show the precise character of his invention. He began with the Hughes microphone, and this sufficiently shows that he was working on the line of an unbroken contact with variable pressure. Every instrument he made shows this, and their dates are indication enough of his progress. He modestly describes his invention as the production of an adjustment (ans. 9, p. 77); and in one sense it was, for

what he undertook to produce and did produce was a microphone, which, in spite of changes of temperature, jars and accidents of usage, shouting and abnormal noises, should always possess the most delicate sensitiveness, always be in just the right condition for use, and continually vary but never interrupt the current. Now, it is needless to say that an instrument which does not possess any of these qualities does not possess the patentable features which can bar Mr. Blake's claims.

The Case of Mr. Blake.

Mr. Blake's exhibits and the proof about them are as follows: —

No. 1 is a Blake transmitter, No. 40,715 of the manufacturer's series, made in June, 1880, taken out of the stock made for commercial use. It does not differ from Mr. Blake's Patent Office model except in some insignificant details, which have no concern with this interference (p. 69).

Nos. 2 and 3 are old instruments (Nos. 35 and 40 of the manufacturer's series), made in December, 1878, before the date of Chinnock's application (p. 69).

No. 4 is No. 1 of the manufacturer's series and therefore made in November, 1878 (p. 73).

No. 5 is a microphone made by Mr. Blake in June, 1878 (p. 76).

No. 6 is a microphone with one electrode mounted on a diaphragm, made by Mr. Blake about the middle of July, 1878.

No. 7, made at the same time, had both electrodes mounted on springs and provided with inertia weights; the contacts adjustable by gravity. This embodied the first conception of the inventions; *i. e.*, it had the elements of inertia, weight, spring-carried electrodes and delicate adjustment (p. 78).

No. 8. Drawing of an instrument since destroyed. It is an improvement on No. 7, containing the same elements. Made before July 27, 1878 (p. 80).

No. 9. Made before July 27, 1878. This has, substantially in their present form, all the elements of Case 2 and of both issues of

Case 3, though the details are less perfect than at present. On the first trial of this instrument over a line from one building to another, three hundred feet apart, half a page of a book was read and every word understood.

Concerning it, Mr. Blake testified (p. 83) : —

"Hearing the performance of this instrument, I became satisfied that I had covered the broad principle of an important invention; and from that time I devoted myself to a series of careful experiments to determine the length and strength of the springs, forms of points, weights and qualities of surface of carbons, materials, sizes and thickness of diaphragms, and methods of adjustment of the parts necessary to produce the most nearly perfect results.

"*Int.* 17. How do you fix the time when this instrument, Exhibit 9, was made as being prior to July 27, 1878?

"*Ans.* By a certain entry made in a pocket diary of that year."

Mr. Blake testifies that it was during the fortnight before July 27, though he cannot fix the exact date. But a letter produced and dated July 12, shows that a gentleman who assisted him in some experiments was invited to come the next day (13th) and see his microphone and *improved* telephone.

After making No. 9 he went to the mountains. While there he devised, and on his return in September constructed, No. 10. During September he made No. 11 (p. 86). Very early in October he showed his work to the Bell Telephone Company, and made an arrangement with them about it. During the first week of November, 1878, instruments began to be made in Boston under Mr. Blake's supervision for general commercial use. Nov. 9, one was shipped to the Law Telegraph Company in New York, with directions to use it without change or readjustment, in order to ascertain whether it was so perfect that it would bear the journey without injury; which it did, and drew from the manager of the Law Telegraph Company a letter of enthusiastic admiration (p. 93).

By Dec. 26 (about the time Chinnock's application was filed) ninety-eight had been put into use; then the manufacture ran along twenty-five a day, and kept increasing till by July 1, 1880, about nineteen and one half months after No. 1, nearly 45,000 had been manufactured.

The Case of Mr. Edison.

The Case of Mr. Edison and his Inventions involved in these Interferences, 2 and 3.

Mr. Edison has undoubtedly done a great deal in the direction of improving some forms of the speaking telephone; but that special form of telephone with which his name is particularly connected — to wit, the so-called Edison carbon telephone, an instrument which has been very widely used in this country and abroad, and which is now used under license from the Bell patents — is of an entirely different character in its structure from anything shown in these interfering applications, and it does not employ any of the features specifically involved in the interference now under consideration, although it is undoubtedly true that other features involved in other interferences, not now to be discussed, are common to all the instruments at present before the examiner. Mr. Edison is a professional inventor: that is to say, it is not his business to manufacture apparatus for the sake of a manufacturer's profit; his work has only one end and purpose, and that is, to obtain patents for every device which he invents, if he thinks it is of such value or practical utility that the public will ever want to use it.

At the time when the inventions now in controversy were made he was, moreover, employed by the most powerful corporations of the world dealing with electricity — namely, the Western Union Telegraph Company and its associate corporations — for the purpose of inventing or improving electric speaking telephones, which they wished to introduce in competition with the Bell Telephone Company, upon whose patents they were then making an attack which they have since acknowledged could not be maintained. That company provided him with most ample means, not merely for experimental research, but for making, *ad libitum*, every kind of apparatus which he might desire to try or to put into use. He possessed at Menlo Park a machine shop and laboratory unequalled in the country, with a large corps of trained assistants. For perhaps not less than two years he devoted a large part of his time to the subject of the speaking telephone. It appears in evidence that hardly a day passed when he did not make some sketch or device for some

kind of alteration or modification of supposed or conjectured or possible value, and a large number of these were immediately tried in experimental instruments.

Now it is certainly true, and we are quite willing to concede this, that when he has produced and given to the world, put into general use, an actual working instrument possessing intrinsic and practical merits which enabled it to achieve commercial success, and when, in competition with another rival inventor he seeks to trace back this perfected apparatus to the date of his first conception, — all the intermediate occupations of his time, directed exclusively or almost exclusively to the subject of telephones, must be taken into account in considering whether he laid aside the subject, or was exercising that diligence which the law requires to enable a man to date his finished invention from the time of his primary conception; and in this respect he will stand more favorably than one who has laid aside telephony for a different branch of research.

On the other hand, it does not follow that because he is an inventor, he is the sole inventor; nor does it follow that because he has produced one class of practical working instruments, he is to be considered or has any claim to be considered the inventor of other classes which he has never produced in any such shape that the public desired to use them. On the contrary, considering his purposes, his means, his facilities, the stimulus he was under, there is every reason to say, that of the thousand devices or modifications which are represented by his daily and almost hourly sketches, none are to be regarded as giving him a date against the perfected instruments of an independent inventor, unless and until they culminated in a practical, successful apparatus. For a sketch, or even a working model, made, broken up, thrown aside, unprovable except by bringing the parts out of the scrap heap and the sketches out of the garret, does not amount to invention in the sense of the law. It does not make any difference that in telephony every model is in some sort a working instrument, or contains such parts that it can be tested by speaking to it; for it still remains an experimenter's model, until actually constructed in a form in which it is ready to be delivered to the public for the general uses of the community. The most that can be said of this kind of work is, that when the originator has pro-

duced and given to the community a workable instrument, by physically putting it within their reach, or — what the law considers, we suppose, to be the same thing — has taken the steps the law requires to lay it before the community, by describing it in an application for a patent, filed in the Office, then, and only then, in competition with another rival inventor, he may date back to the day of his first conception of the precise thing, and by his other exertions in the same general field may excuse himself from not having devoted every minute of the intervening time to the particular instrument in question.

Application of these Considerations to the Case at Bar.

So far as the case stands between Mr. Edison and Mr. Chinnock, it is certain that all Mr. Chinnock did was to produce an experimenter's model, the performance of which was so very bad that those interested with him would not spend a cent either to experiment with it or patent it. Now, remembering the settled rules of law as to the race of the diligence between two inventors, there can be no doubt that that kind of success, or want of success, on the part of Chinnock can be very fairly met by experimenter's models or instruments equally rude made by Edison, if of earlier dates; and there can be no doubt also that as between two such men, other things being equal, the one who devoted his whole time, night and day, to the general field and the general work of improving the telephone, ought to stand better than one who, having done something which his associates at any rate found no good in, laid it aside for six months without any further show or pretence of activity.

But as between Mr. Edison and Mr. Blake, the case stands very differently. Mr. Blake, in the middle of November, 1878, presented to the world, in a thoroughly finished practical working form, an instrument which, exactly as he then presented it, has been found to be so perfect for the ends in view, that it has been universally adopted in this country and in Europe to the extent of over 50,000 instruments in two years. We submit, in the first place, that such a production cannot be overcome by any after recollection on the part of Mr. Edison, that among his notions or experiments which the

world had never heard of, the results of which are now found only in rude sketches or in the scrap heap, there were some which resembled some of the features in the Blake transmitter, or which, in the light of Blake's success, he now sees might have been worked out and developed into something like the Blake, if he had applied sufficient invention and perseverance to them.

These remarks apply especially to Mr. Edison's application No. 178, filed June 2, 1879. Mr. Blake's instrument had then been in commercial use for seven months, to the extent of many thousands. Mr. Edison knew of this. He procured from Mr. Bergmann, in a way which must be considered illicit, a Blake transmitter, made by the Bell Company under license from Mr. Blake for commercial use. That very instrument, made by Mr. Blake or his licensees, Mr. Edison had the assurance to file in the Patent Office as the model for his own application. His drawing is a drawing of that instrument (Edison, Cross Examination, pp. 34, 35). There is not the slightest pretence that he ever constructed an instrument which as a whole resembled this.

The striking and prominent feature of Mr. Blake's transmitter is, carrying the electrodes on long, slender springs, the outer one of which is heavily weighted while the inner one is reduced to the lightest possible mass. The Edison carbon transmitter, so called, the only one of Mr. Edison's telephone instruments which has ever gone into general use, has no spring at all, no movable electrode, but the carbon and what corresponds to the anvil or outer and resisting electrode of Blake is firmly screwed into the same cast-iron frame which holds the diaphragm; and the Blake specification expressly rests on this distinction. We submit that under the circumstances, everything attempted to be covered and claimed by Mr. Edison's application 178, filed June 2, 1879, must be taken to have been no more than an experiment or thought, which he had himself abandoned as impracticable or worthless in his hands until Mr. Blake had demonstrated his own success by the introduction of his transmitter into extensive public use. We will presently examine the details of this.

Mr. Edison's first application, No. 158, filed Nov. 11, 1878, stands somewhat differently. There is no reason to doubt that it was filed in

the ordinary course of his occupation as an inventor, for the purpose of covering something which he believed he had invented, and considered a valuable improvement; and as he is the first of these three interfering parties to come into the Office upon the matters covered by that particular application, it is undoubtedly true that we must show enough to overcome him in dates, if we would contest the precise thing shown in that application. It must be observed, however, that the instrument shown at A, B, in Fig. 1, which is the interfering instrument, is essentially different in many important features from anything found in the Blake transmitter; and although it is true that this instrument of Mr. Edison's answers the issue in Case 2, it certainly is no answer to claims which are or might be made on improved and controlling features in Mr. Blake's transmitter. In Mr. Blake's instrument the inertia or anvil electrode consists of quite a large mass carried on the end of a long and tolerably slender flat spring, which is attached to the frame. In Mr. Edison's transmitter, as shown in his application 158, all the parts are mounted on the diaphragm itself. It does appear, however, that the initial pressure is given and was intelligently intended to be given by a spiral spring adjusted by a screw, and that the variations of pressure produced by the vibrations of the diaphragm when spoken to are due to the inertia of a heavy plate carried behind the carbon, and to the momentum of the parts when motion is set up by the vibration of the diaphragm.

That application also shows, and the third claim expressly indicates that the operation of this instrument depends upon the inertia of the electrode plate D, which plate is not rigidly held in the frame, but is free to yield and move and thus preserve a contact with the diaphragm under all its vibrations. Mr. Edison shows this same instrument in the final specification of his British patent 2,909, of 1877, which specification was signed by him in New York, on the twenty-fourth day of December, 1877. We suppose, therefore, that it must be admitted that at that date he had completed the invention, and had not abandoned it, but intended to patent it. He endeavors to date his conception back of that, and undoubtedly shows a sketch dated July 5, 1877, Exhibit 2–12, which involves the same idea, and indeed cannot go upon any other theory. Several other draw-

ings during the summer and autumn of 1877 show the same feature. Mr. Edison testifies that he made one of these instruments soon after July 5, 1877 (ans. 43, p. 12), and altered it into various forms shown in those sketches, — all, however, embodying the same idea. One of these sketches, dated Sept. 21, 1877 (Exhibit 165–12), shows several variations of detail in this apparatus, and has this written on it: "Working by momentum; no adjusting screw."

Although, for the reasons we have already stated, we should not consider that either these sketches or the experimental instruments then made and not preserved amounted of themselves to complete invention in the sense of the patent law, yet we cannot deny that when adduced in support of either a finished instrument, or of a specification filed before any one else had occupied the market, they are sufficient evidence of date of conception to enable him to go back to them. The question is, however, an important and interesting one, and we submit it to the consideration of the Office. If it be decided that it is sufficient evidence for that purpose, then Mr. Edison can go back of Mr. Blake for all that that instrument embodies, because Mr. Blake's work did not begin till about July 1, 1878; he can also go back of Mr. Chinnock, because Mr. Chinnock's first work, whatever it was, is placed by his preliminary statement not earlier than November, 1877, and his first proof of anything definite hardly goes back so far.

Mr. Edison, however, has undertaken under this issue, and for the purpose of controlling Mr. Blake's invention, to prove that he conceived some ideas of his own early in 1877, quite different from those exhibited in his drawing in Fig. 1 of his application 158, and resembling the features which are found in the Blake, and which are not found in any application or published document or apparatus of Mr. Edison, ro any one else, until his application 178, for which he used one of our own transmitters as a model. We submit in the first place that when Mr. Edison, having gone through with his ideas and experiments in the summer and autumn of 1877 (such as they were) upon that class of battery transmitters in which the varying pressure was derived by carrying the anvil electrode on a weighted spring, — if indeed he ever distinctly conceived of that mode of obtaining variations of pressure, — broke up all his models, and deter-

mined as his matured judgment that the only one of them which, as he invented them, was of any value, was the precise form shown in Fig. 1 of application 158, and manifested that determination and that judgment of their value by inserting only that form in his English specification of Dec. 24, 1877 (although it was a specification crowded with every kind of device), and by inserting only that form of the type in his interfering application 158, he cannot recur to what he had so abandoned and pronounced worthless, after Mr. Blake's inventive skill had demonstrated that in his hands the form finally adopted by him was of the utmost practical and commercial value; or in other words, for all the benefit which Mr. Edison is to have under application 158, he must be confined for details to the details there shown, with such extension of the broad principle as that instrument warrants, but cannot thereunder prove or claim details of great practical value, which he never undertook to offer to the public or to the Office, or to describe in any publication, until his application of June 2, 1879, six months after Mr. Blake's apparatus had gone into successful and general use. We submit, therefore, that if the tribunal should award priority to him, as we suppose they must, under the broad language of the issue in Case 2, they should expressly say in the decision that it does not award him priority upon improvements in the form of the apparatus shown in that application.

Details of Mr. Edison's Case and Examination of his Proof.

Perhaps this issue might be left here, but we proceed to call attention to some sketches and details of evidence which Mr. Edison has —improperly, we think— undertaken to put into the case, although his application affords no basis for them.

In his fourth answer, page 3, he refers to his patent 203,014. That patent has nothing to do with the features here in controversy, because it was for a circuit breaker. Mr. Edison had the idea in his early work that speech could be transmitted — not, it is true, by a single contact point and diaphragm, always operating to break the circuit, but—by a considerable number, four or six or some other number of contact points arranged in this case on different diaphragms, each responding to different tones, and not breaking the circuit all at

the same time. Later knowledge has of course shown that that kind of instrument is as worthless as any circuit breaker. His patent 203,014 was for an instrument of that class; and indeed the fact that the Office has put his application 158, and not that previous patent, into this interference, is a sufficient proof and decision that the feature of this issue is not found in it. Moreover, that instrument itself does not exhibit inertia or yielding pressure. There is no more weight in the electrodes than was necessary for their proper mechanical construction.

It is obvious that there was no intention of taking advantage of momentum or weight, because they were not in constant contact with the diaphragm. Moreover, they were not movable in the sense in which electrodes of the Blake transmitter are movable; that is, so as to preserve contact with the diaphragm under all circumstances. They were indeed mounted on springs, but these springs were merely arranged for the purpose and with the effect of enabling the adjusting screws — one near the bottom tending to press it towards the diaphragm, and the other near the free end of the screw holding it back from the diaphragm — to conveniently adjust and hold the contact point, not in contact with, but, in the language of the specification, in proper *proximity* to the vibrating diaphragm, allowing at the same time such possible yield that when the contact piece was occasionally knocked away by a strong vibration of the diaphragm, it would return to its proper bearing on the screws.

His next exhibit is 42–11, and is a sketch dated April 1, 1877. It is obvious that any electrode carried on the end of a spring opposite the diaphragm will, from the necessities of its mechanical construction, possess some weight, and therefore some inertia and momentum; but it is certainly true, as a matter of law, that to leave in the electrode that weight which is inseparable from the necessities of mechanical construction is a very different thing from the invention of purposely contriving to put there a weight which, by virtue of being a weight, should exercise a special and important function, — controlling the operation of the machine and giving it efficiency. Now, it is obvious, from looking at the drawing 42–11, that the resistance to the motion of the diaphragm which was to make the variations of pressure was, and was intended to be, due

to the springs alone, which by that diagram are expressly directed to be made "stiff"; and when the instrument was so made, the springs, two or three of which remain, and drawings of which are given at the close of Mr. Edison's exhibits, were so extremely stiff and short that the weight carried at their ends would be entirely inconsiderable and negligible, so far as inertia and momentum were concerned, in the small range of motion allowed under the slight movement of the diaphragm.

There is nothing in any of the diagrams to show that Mr. Edison attached the idea of momentum or inertia to this apparatus; on the contrary, upon comparing it with the instrument Exhibit Mica Diaphragm, which is drawn on the same sheet that contains the drawing of these springs, it is obvious that when he made that diaphragm apparatus he perfectly understood the proper relations between the spring and the weight needed to bring this principle into play with a flat spring, and that apparatus shows a weight which is thirty or forty fold as heavy when compared with the spring as the so-called weight in the apparatus 42–11. There is no doubt that that mica diaphragm embodies distinctly and unequivocally the form of this feature as contained in the Blake transmitter. But that mica diaphragm instrument was not made until the summer of 1879, long after Mr. Blake's application was filed, and his instruments had gone into commercial use. (Edison, ans. 52, p. 17.)

His next piece of proof is Exhibit 106–11, a sketch dated May 26, 1877. It is obvious here, that there was no intent to employ an inertia mass to produce variation in pressure, but that the stiffness of heavy springs, tightly screwed up and pressing with all their elasticity against the diaphragm, was what was relied on. The same remark applies still more strongly to his Exhibit 112–11, dated May 31, 1877, which shows a spring of massive proportions, certainly not less than one third of an inch thick. Speaking of this, Mr. Edison says in his thirty-eighth answer, p. 10: "The difference in pressure was mainly produced by the inertia of this large bar." It is true that some weights were afterwards added to them, but it is difficult to conceive that any weights could make this stiff bar any

more rigid under the feeble vibrations imparted by the voice than it could be without it.

Some of these things were published in Mr. Prescott's book on the telephone, but only in the second edition; that is to say, Chapter 6, written by Mr. Edison for the first edition descriptive of his inventions, did not contain them, but they are found in a later chapter which was added in 1879, six months after Mr. Blake's transmitter had gone into general use.

Case 3. Edison's interfering application in this case is his No. 178, filed June 2, 1879. His proof about these two issues enforces what we have already said about this application. Blake had two springs, but the value of two springs *per se* is not very apparent. In Blake, however, they pressed *towards* each other, and thus determined the break to be elsewhere than at their contact. Now, although Edison took our instrument for a model, he was so utterly ignorant of it, and in such a hurry to thrust his application into the Office, that he did not even stop to understand it. He merely says that "the spring arm *o* is also stiffer than the spring arm *i*," and he does not hint at the most important fact, that these springs co-operate by pressure against each other for an important purpose.

Nor does Chinnock show or describe two springs which press towards each other. There can be no doubt about Blake's priority on this.

Moreover, this is a feature which Edison never devised.

Sketch 42–11 shows five stiff springs; and Mr. Edison expressly testified that they were all just alike and all arranged alike in the instrument (Edison, cross-ans. 173, 174, p. 35), whereas in the Blake they were arranged so as to push in different ways. That this is the case is more obvious from the fact that in every other exhibit or sketch adjusting screws are shown, which press all the springs in the same direction against the diaphragm, making that bear the whole strain.

Mr. Edison undertook to intimate that sketch 112–11 (May 31, 1877) showed two springs pressing in different ways; but the small piece, marked "platina," is not a spring. In the first place, it is not the material of which to make a "spring"; and in the next place, this sketch, taken in connection with others, shows what it was for.

Exhibit Sketch 99–11, of May 25, 1877, shows in its middle figure the springs of his application, 141, on *opposite* sides of the vibrator, in interference in No. 1 and not here. In the others, the springs all press towards the vibrator. This sketch has the following, in Mr. Edison's handwriting : —

" Plumbago secured to platina cup, and faced with a platina cap, for the purpose of preserving it from abrasion, and get the full effect of pressure."

Four days after, he made a sketch (May 29, 1877, 111–11) of the same instrument shown in 112–11, and this bears the legend, in his hand : —

" Platina-faced to prevent abrasion."

His very next sketch — 112–11, made May 31, 1877 — of the same thing obviously shows only another way of mounting what is a platina facing to prevent abrasion.

This sketch (111–11) is marked " actual size," and it is enough to look at the heavy bar of wood there shown (testified to as of the the correct size, — Edison, ans. 39, p. 11), to perceive that it does not embody, in any conceivable sense, Blake's delicate and sensitive electrode carriers ; that it does not answer to the phrase, " a spring," or " a flexible, etc.," as used in Case 3.

It is not worth while to discuss the second issue of Case 3 ; the feature involved is called the "weighted circuit governor." The parts referred to in this claim, and shown in Blake's specification, and in the Blake transmitter, filed as Edison's model, were never so combined by Chinnock ; and Edison never possessed an instrument which had them so combined till he got the Blake transmitter from us.

CONCLUSION.

The results at which the Office should arrive are the following : —

Case 2. " The yielding weight connected with the movable electrode, to resist the movement of the diaphragm, and modify by its inertia the variation of pressure between the two electrodes."

This is perfectly shown in Blake's model and drawing, described in his specification and expressly claimed by him. Features which may fairly be called by these names, and which embody and were intended to embody the mode of operation indicated by the reissue, are found in Edison's specification, and he was the first inventor of that combination. But there is an important practical difference between the construction shown at *a b*, of Fig. 1, of Edison's application 158, of Nov. 11, 1878, and the construction shown in Blake's specification, and Blake is entitled to priority on all that concerns that difference.

Chinnock did not make an instrument in which the parts did operate or were intended to operate by variation of pressure, and consequently it should be adjudged that he is not the inventor of anything which come within this issue.

Case 3, *Issue* 1. "The springs, in combination with the piece of graphite or similar material between them and the diaphragm of a telephone."

Blake shows and claims this. He is entitled to judgment of priority in this: —

As against *Edison*, (1.) because, in the race of diligence, Blake was the first to perfect this improvement in a form adapted for practical use. Edison has not shown anything earlier than Blake which, under the circumstances of the case, he is entitled to set up against Mr. Blake. Upon this see Summary, p. iii, *supra*.

(2.) Because Blake combined his two springs to press against each other, and Edison did not make this combination before Blake.

As against *Chinnock*, (1.) because Chinnock never combined similar parts to act in a similar way.

(2.) Because Chinnock never combined two springs to operate against each other.

(3.) Because Chinnock's application does not show "graphite or similar material."

(4.) Because, in the race of diligence, Blake was the first to perfect this improvement in a form adapted for practical use, and Chinnock has not shown anything earlier than Blake which, under the circumstances of the case, he is entitled to set up against Blake.

Issue 2. "The combination in a telephone of an electric circuit, a vibrating diaphragm, and a flexible weighted circuit governor."

Priority with Blake.

(1.) This issue, properly construed, refers as one of its features to a flexible spring, weighted at the end, and carrying one electrode, and implies a weight placed in that position; and combination for the purpose of performing some important function. Mr. Blake shows this in a form which practice has shown to be an improvement over anything before accomp'ished. Mr. Edison did not produce this combination before Mr. Blake, and has not shown himself entitled to date back of his application No. 178, of June 2, 1879, for the purpose of anticipating Mr. Blake in this feature.

(2.) Mr. Chinnock did not make such a combination as that shown by Blake, and referred to in this issue. The electric circuit is declared to be a component part of the issue; and the circuit of Mr. Blake was unbroken, and by the construction of the parts and the manner in which they were combined was kept unbroken during the operation of the instrument. The circuit of Mr. Chinnock was broken at each vibration, and the parts were constructed and arranged so as to break it. In telephony a constantly interrupted circuit is not the same as a never-interrupted circuit, and therefore the two instruments differ in an essential component of the combination.

(3.) The combination of Mr. Chinnock is not the same as the combination of Mr. Blake, because the mode of operation for which the parts are combined in one is not the same as the mode of operation for which the parts are combined in the other.

Respectfully submitted by

CHAUNCEY SMITH,
J. J. STORROW,
W. W. SWAN,
For Francis Blake.

BOSTON, February, 1881.

United States Circuit Court,

SOUTHERN DISTRICT OF NEW YORK.

IN EQUITY.

J. H. IRWIN AND THE WESTERN ELECTRIC MANUFACTURING CO.

v.

THE METROPOLITAN TELEPHONE AND TELEGRAPH CO. ET AL.

ARGUMENTS OF

J. J. STORROW, Esq.,
CHAUNCEY SMITH, Esq.,
for Defendants.

REPORTED BY UNDERHILL & ADAMS.

BOSTON:
ALFRED MUDGE & SON, LAW PRINTERS, 34 SCHOOL STREET.
1881.

CONTENTS.

ARGUMENT OF MR. STORROW.

ARGUMENT OF MR. CHAUNCEY SMITH.

United States Circuit Court,

SOUTHERN DISTRICT OF NEW YORK.

J. H. IRWIN AND THE WESTERN ELECTRIC MANUFACTURING COMPANY,
v.
THE METROPOLITAN TELEPHONE AND TELEGRAPH COMPANY *et al.*

IN EQUITY.

Before BLATCHFORD, *J.*

NEW YORK, June 10, 1881.

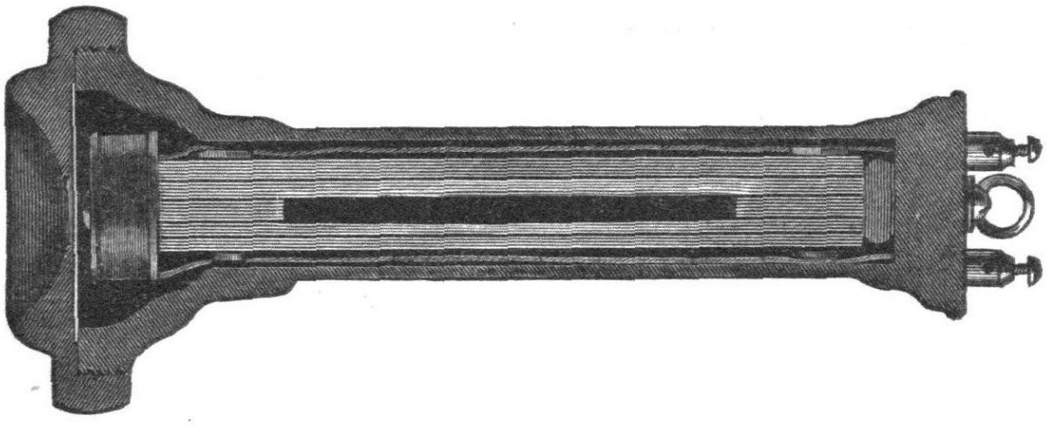
APPEARANCES:

For the Complainant, FREDERICK H. BETTS.
For the Respondents, CHAUNCEY SMITH *and* J. J. STORROW.

ARGUMENT OF J. J. STORROW, ESQ., FOR DEFENDANTS.

May it please the Court, the answer to the plaintiff's claims is in substance that the defendants do not infringe; that the plaintiff's patent is a comparatively narrow patent for an improvement in an existing machine; and that the precise improvement, the substantial improvement introduced by the plaintiff, is not found in the defendants' apparatus, the Blake transmitter. These two inventors, Mr. Irwin and Mr. Blake, have produced improvements in telephone transmitters. Mr. Blake's was introduced into commercial use within a few days after the granting of the plaintiff's first patent sued on, so that it is obvious they were both independent inventors, and the question is as to the relation of each to the other. In order to understand that, I will ask your Honor to go back a little and see what was the existing machine which they improved, and what is the

art to which these instruments relate. They relate to the transmission of articulate speech by electricity, they are instruments for that purpose. The essence of all electric speaking telephones is, first, that they shall have a sensitive part which will take up from the sound waves of the spoken word the vibrations which are peculiar to it, and which shall excite or cause in some way or other in the electric circuit variations of current-strength which correspond to the motions of the transmitter. The instrument which your Honor has before you (the well-known Bell magneto telephone) is one form, and the operation of that — to go through it a little differently from the way it was stated the other day — is substantially this : —



You see the thin soft-iron diaphragm next to the flaring mouthpiece. Directly behind that is an electro-magnet, consisting of a small core of soft iron about one fourth of an inch in diameter and three fourths of an inch long, surrounded by a coil of a great many turns of fine copper wire, insulated by its silk covering, and wound on a boxwood spool to keep it in place. This small soft-iron core — purposely made small and of the best soft iron — is magnetized by being mounted on one end or pole of the long and rather heavy permanent magnet. That magnet is made of four blades or leaves of steel, each of which is permanently magnetized, and the four then screwed together. The soft-iron core — both on account of its small size and its material — will not of itself permanently retain any considerable magnetism, but as arranged it is kept magnetized by induction from this powerful steel magnet.

If I pass an electric current through that wire in one direction the

magnetism of this core is instantly increased; if I pass a current in the other direction the magnetism is decreased. Conversely, if by any means I can increase the magnetism of that core, a current in one direction is instantly generated in the coil and in all the wire in circuit with it; if I diminish the magnetism of that core, it starts a current in the other direction. A change in the magnetism of the core produces a current in the coil; conversely, a change of the current in the coil produces a change of the magnetism of the enclosed core. The first of these facts was discovered long ago by Faraday, — the law of magneto induction. It is also found that if I take a piece of soft iron and bring it close to the magnet, the influence of that approach is to momentarily increase the magnetism of the magnetic core; if I move it away it diminishes the magnetism of the core; and therefore, by bringing it towards and taking it away I have a means of increasing and diminishing the magnetism of that core, and therefore generating currents in a complete closed circuit, part of which forms the coils of that magnet. If I had another one of these instruments at the other end of the circuit, a movement of a soft-iron armature [*illustrating*] drawing *that* way, in front of this core, would generate currents in the manner I have stated; these currents, passing through the circuit and through the coil of the other instrument at the receiving end, would increase or diminish the magnetism of its core, and would thereby produce a sound in a way I will presently describe. This effect is not produced by a movement of an armature at a distance from its core, but by a movement in close proximity, because, within ordinary distances, other things being equal, the effect increases inversely as the square of the distance. Now, when I speak to this instrument the sound waves vibrate this diaphragm, or the central part of it, to and fro, and I have there, on a very minute scale, the operation which I have been describing. I increase and diminish the magnetism of this little core, and in turn that generates a current in one direction when the magnetism increases, and in the other direction when it diminishes.

As these currents pass over the line and through the coil of the instrument at the receiving end, which also is exactly like the drawing, they alternately increase and diminish its magnetism; the stronger the current in one direction the more it increases

the magnetism; the stronger the current in the other direction, the more it decreases it. In front of that core in the receiver is placed this diaphragm, supported at the edges, and at its centre drawn towards the core by the magnetism of the latter. If that magnetism is increased, the disk is drawn a little more towards the magnet; if the magnetism is diminished, the elasticity of the plate causes it to recede. Here we have, therefore, the means of causing that plate of the receiver to move, very slightly it is true, but still to move to and fro. Those motions are imparted to the air adjacent which takes up the same motion from it, and that produces waves; and when these waves succeed each other at the rate of thirty-two to the second, or faster, they become audible as sound to the ear of the listener. The sound is very faint; you need to have a peculiarly shaped mouthpiece, and that is a thing of some practical importance in the apparatus.

The COURT. — When you speak at this surface and it vibrates in this direction, does that increase the current?

Mr. STORROW. — It depends upon which way the wire is wound around it. If I wind the wire one way it increases it, and if I wind the wire backward it diminishes it. One cannot tell except by knowing which way the wire is wound. So, if I push this disk in that direction, it generates a current in one direction; if I draw it away, it generates a current in the other direction.

The COURT. — It does not make any difference in which direction, does it, practically?

Mr. STORROW. — No; it does not make any difference which way the current goes first, nor whether the two disks move in the same direction or different directions. It is the succession of motions and the succession of changes which are important, and if these correspond, it is no matter whether the correspondence in direction be direct or inverse.

In the earliest instruments a battery was included in the circuit which went through here. That kept a constant current flowing in one direction, and also kept the cores magnetized. These magneto currents, when they were generated in the same direction with the constant current, increased it; when they were in the opposite direction they partly neutralized and thereby diminished it; and in that

way these magneto currents — although there was a current always flowing in one direction — served to momentarily increase or diminish it, according as these two currents were in the same direction, and were added, or were in an opposite direction and one tended to neutralize the other. These magneto currents, however, are only excessively slight and feeble, so delicate, and so rapid in their alternations, that no instrument can even detect their presence, except the telephone itself.

THE COURT. — Practically, what does that amount to? As long as there is a current in one direction and a current back in the other direction, how do these variations affect it?

Mr. STORROW. — Suppose here is the receiver. We magnetize that core and it pulls this diaphragm towards me, just as if I press it with my finger on the other side; it bends the disk a little. If the magnetism of this core is a little increased, it pulls it still more towards me; if it is diminished, then the elasticity of the plate draws it back again. That plate is not a perfect plane when it is on there, because the pulling of that magnet deflects it a little. If you increase the pull or increase the magnetism of that core, you draw the plate and make it bulge inward still more; if you diminish the magnetism of this core there is less pull and the plate flies out a little. Therefore, whenever you increase the magnetism, you move the centre of the plate in one direction; whenever you diminish it, it flies in the other direction. If you make those movements which impart the same movement to the air adjacent to them, succeed each other about thirty two or forty times a second, then the waves become audible, and the sound, that is, the pitch of that sound, depends upon the rapidity with which these vibratory or to-and-fro movements succeed each other. The variations of current which work the receiver are thus due to the action of the transmitter, and therefore whenever the diaphragm of the transmitting magnet moves towards it, it generates a current in one direction; it either increases or diminishes (it is immaterial which) the energy of the magnet of the receiver, and this pulls the plate more, — that is, moves it in one direction, or, partially releasing it, lets it fly back in the other. If I pull this disk of the transmitter in this way [*indicating*], I generate a current which moves in one direction; when it flies away, it generates a current in

the other direction. Those currents going through the circuit increase or diminish the magnetism at the receiver and pull the plate or allow its elasticity to draw it back. As often, therefore, as we move this plate in front of the transmitter, just so often will the plate move in front of the receiver.

The COURT. — When this moves towards you the other one will move away?

Mr. STORROW. — It may either move towards or away. It does not make any difference. The question is the succession of vibrations, not which way they move. It makes no difference so long as one does what the other does. When *this* diaphragm moves in, that may move in; or when *this* moves in, that may move out. It is totally immaterial which, because the question is not whether they move in the same direction, but whether the rapidity with which they move and the frequency with which they move, and the manner in which they move correspond.

The COURT. — That is what I said some time ago, that that was not of any consequence.

Mr. STORROW. — Yes, sir, it is the question of how many times they move. It is the vibration irrespective of the direction; that is, there are two directions, and which you begin with is of no consequence.

Further than that, the strength of the current generated depends upon the extent of the motion of the exciting, or, as it is called, the inducing disk. A loud sound will make it move more than a light sound. A loud sound will therefore generate a stronger current than a feeble sound. At the receiving end a strong current will make more violent changes in the magnet, and will make the plate vibrate more violently.

The consequence is that the plate at the receiving end moves when the plate at the starting end moves, and corresponds also in the extent of its motion, for the violence of motion in the transmitter causes and therefore controls the violence of the currents, and the violence of the currents controls the violence of the movements in the receiver, which indeed they cause. Thus by means of this link, — the variations of the electric current, — the motions of the receiver are linked to the motions of the transmitter; they are linked together because

the current changes, which are caused by the motion of the one, do themselves cause the motion of the other. But if the two are to be faithfully linked together the link must be faithful. It is easy enough to make the motion of the receiver obey every variation in the current-strength, but this will be useless unless in turn the current obeys the transmitter; that is, in its variations follows the varying movements of the transmitter. In order, therefore, that every conceivable motion of the transmitter (taken up by it from the most complex sound waves) shall be copied by the disk of the receiver (there to generate the like complex sound waves for the benefit of the listener, that he may recognize the same sound), it is absolutely essential that the varying movements of the transmitter shall cause the like and counterpart variation in the strength of the current. It is the employment of this special character of current variation which gave to Mr. Bell the link he employed to tie together the transmitter and the receiver, and which enabled him to transmit speech.

It is obvious that in such an instrument it is not material, so far as result is concerned at least, how the electricity is generated or whence it is procured. The essential is, first, that the transmitter shall have a motion which exactly copies the sound waves, and this is accomplished by causing the sound waves themselves to move the plate of the transmitter; next, that every motion and every variation of every kind in this motion shall not merely cause some change but a corresponding change in the current; and finally, that at the receiver every change of current shall produce a corresponding change of position — that is, of motion — in some part of the instrument, which will impart its motion to the air. This being done, the air motion at the transmitter is copied by the air motion at the receiver, the ear of the listener is similarly affected, and the same character of sound that was uttered at the one is heard at the other.

Mr. Bell or some one — that is not the question here — first impressed upon the electric current this special character which made it serve as this link. The task of subsequent constructors, among whom are Mr. Blake and Mr. Irwin, is to so build their instruments as to secure the required correspondence in the greatest perfection, and make the transformation from sound waves to electric waves,

and then back again to sound waves, take place with the best fidelity and with the smallest waste of effective power.

The COURT. — You must get your two instruments as nearly alike as possible?

Mr. STORROW. — No, sir; it is not necessary.

The COURT. — Suppose you make the plates of different size or thickness?

Mr. STORROW. — That does not make any difference. They have been made of boiler iron, although pretty large.

The COURT. — You cannot use boiler iron at *one* end?

Mr. STORROW. — You can. I used a safe door one day, and I have used a piece of cast-iron weight.

The COURT. — Can you vibrate the thing rapidly enough?

Mr. STORROW. — Yes, sir; that is the wonderful thing which nobody would believe unless it was found to be so. The fact is that the plates are preferably thin, and in order to work practically they must be somewhere in the neighborhood of the thickness of those before you, though in some instruments they are made thicker. The fact is that almost any kind of metal plate, thin or thick, can be vibrated, some more easily than others; but when they are arranged in a circular plate they will take up not merely one special rate of vibration as a piano string does, but they will take up with more or less ease any kind of vibration which the voice may bring to them. A plate will vibrate in two ways.

If you strike a piano string with the hammer, it will be thrown into vibrations which will continue for some time after the hammer has fallen back. But under these circumstances it will vibrate a certain invariable number of times per second, being the rate (or pitch) to which it is tuned, and though the force with which the hammer strikes it will affect the violence of its vibrations, it will not affect their rate or frequency. These are called free vibrations, because they are those which the body freely takes up, and persists in when left free to vibrate by itself. So an elastic plate when gently struck with a soft hammer will be set into that rate of vibration which is due to its size, thickness, elasticity and tension, — that is, at the rate which is normal to it. But it is also obvious that if the plate be fixed at its edges, and I apply to its centre a continu-

ously acting and sufficient mechanical force, — as by connecting it by a link to a crank pin or a cam, — I can force it to move at any rate and in any manner. These motions are known as forced vibrations. Not only do they have their origin in a force *ab extra*, as in the case of the single blow of the hammer, but they depend for their continuance and for their character upon a force continually applied from without, and imposing upon them its own will and not the will of the elasticity of the plate. The piano string is very ready with its free vibrations; it takes them up easily and persists in them for a long time; but some other bodies, and notably the plates used in telephones, have but a slight will of their own in this matter; very moderate imposing forces will impart to them any special character of vibrations, and thus the sound waves, which are nothing but vibrations of air particles to and fro, are strong enough to force the plate to move as they move, though, of course, such motions are excessively rapid in time, and excessively minute in extent. If the plate filled the only hole in an absolutely solid and impervious wall, it would take up from the word spoken on one side the vibrations belonging to it, and its motion would produce exactly the same agitation of air on the other side, and the same character of sound would be heard; this is the way in which what is spoken in one room is heard, through the closed door or partition, in another. In one sense this is what the electric-speaking telephone does, only instead of linking the two surfaces together by a solid material, it links them together by electric variations as I have described.

We have now and thus produced in the mobile part of the transmitter, by the action of the sound waves themselves, a vibratory motion which always exactly copies their own motion. Our next step is to connect with this such electrical contrivances as that every motion of the plate shall produce a current variation, which in its turn shall be a copy of the motions of the plate, and therefore a copy of the motions of the sound waves produced by the voice of the speaker.

By a law that is familiar to electricians, there are two ways of varying the electric current. You may vary the amount of electric energy that is applied to a circuit, or you may vary the resistance of the circuit, just as in steam pipes you may

put on more or less steam-pressure in the boiler, or you may throttle the current flowing in the pipes by turning down one of the valves. If you take a circuit of a definite known resistance and vary the amount of electric energy that you pour into it, you vary the current. If you pour in some definite amount of electric energy (commonly called the electro-motive force) and vary the resistance of the circuit, then as often as you vary the resistance of the circuit you correspondingly vary the strength of the current, because the law is that the strength of the current equals the electric energy divided by the resistance of the circuit ($s=\frac{e}{r}$), and as it is a simple fraction, you may equally change the value of the fraction and the strength of the current by changing either the numerator or the denominator. The statement of this fact ($s=\frac{e}{r}$) is known as Ohm's law. That instrument before your Honor is of the type in which, the resistance of the circuit remaining unchanged, you vary the electric force of the current by the amount of energy you put into it by the violence of the vibration of the plate. That physical energy that you put into the vibration of the plate is converted into electric energy, just as in the dynamo machine, which runs the electric lights in this building, the power of the boiler and the engine is converted into electric energy. In that instrument, therefore, which is before you, — the magneto telephone, — you vary the strength of the current which traverses the circuit by varying the electric energy.

There is another way, and that is to supply the circuit with a definite amount of electro-motive force by furnishing it with say two cells of battery which supply electric energy. If you increase the resistance of the circuit, you throttle the current; some of that energy is absorbed in overcoming the resistance, and less manifests itself in the current. That is the other way of producing electric speaking telephones. If you can so construct the transmitter that the motion of the vibrating plate, instead of, as in the magneto instrument, varying the electro-motive force, — if you can so construct it that the vibrations of the transmitter shall vary the resistance of the circuit supplied with a constant electro-motive force from a battery, — then you can in the same way vary the current. If you can cause the variations of its resistance exactly to correspond to the movement of the plate of the transmitter, then you have got

all that is necessary for the transmission of speech, — you have got the peculiar current variations which you need for your connecting link.

There are various ways in which the resistance of the circuit can be changed by motions, and the one that we have to concern ourselves with is this. If I take a wire which forms a complete circuit, and put one cell of battery in it, the electricity, or what we call the electric current, or whatever it may be, is propagated through the wire from one molecule to the next. If I cut the wire and separate the ends, the current cannot pass from one end to the other.

If I bring the ends together again the current can pass; and inasmuch as the intimacy of contact between the molecules of the cut ends brought together is not as good as it was in the original mass, the current cannot pass so readily, but encounters considerable resistance, and any contact that you make by cutting a wire and bringing the ends of it together will make a resistance equal to half a mile to two miles of ordinary telegraph wire. But the closer you press together those two ends the less the resistance is. If, therefore, I take the electric circuit and cut it, and bring the two ends together the current will pass. If I press them together slightly, the resistance will be large, and the current feeble; if I press them together, firmly, the electric resistance will be less, and the current will be increased. I have, therefore, by means of varying the pressure between the two electrodes when the current is passing from one to the other, a means of varying the resistance of the circuit, and consequently varying the strength of the current which is traversing that circuit. The more the pressure, the less the resistance, and the less the pressure, the more the resistance. The current increases and diminishes when the pressure increases and diminishes.

If I take a telephone plate, cut the wire which forms a circuit, and mount one of these electrodes on it, and arrange the other suitably behind and in gentle contact with the first electrode, and speak in front of the plate and thus cause it and the attached electrode to vibrate gently to and fro (I mean to vibrate without excessive motion), as it moves in *this* direction, it will increase the pressure; as it moves in *that* direction, it will diminish the pressure. It is difficult, but not impossible, to arrange the parts so that the motions shall not break the

contact although they vary the pressure. Therefore, if I can make that arrangement, I shall have an instrument in which, if I speak to the sensitive plate which carries one electrode, that plate will take up from the air the vibrations which correspond to the word I am speaking, and as it vibrates to and fro, it will vary the pressure at this point of contact, and thereby will correspondingly vary the resistance offered to the passage of the current at that point of contact, and consequently will thereby correspondingly vary the strength of the current passing over the circuit. I then have got a current which is caused by this instrument to vary, not by precisely the same electrical contrivance, but a current which possesses the same variations as the current generated in the magneto instrument, and at the receiver the same effect will be produced. I have got the link I require. This instrument that I have been describing is called an articulating microphone. It is the type of the transmitter in most general use.

When the name was first given to it, it was supposed to have the capacity of magnifying extremely small sounds. That is the instrument you heard of a few years ago (in 1878) by which you were supposed to hear the walking of a fly. If you place it horizontally and let a fly walk over the diaphragm the jar of his tread would produce a slight variation of pressure which produced a slight change of current, and in that delicate instrument, the Bell receiving telephone, it would make motion enough to be heard by the ear placed close to it.

I have now described the means by which the variations of current of the telephone are produced, both by the magneto variety and the variable resistance variety. I want to give your Honor some idea of what constitutes articulation, in order that you may see what is necessary for the transmission of articulation as distinguished from pure musical tone. Your Honor knows that as I speak the vocal organs set the air in commotion. They set the particle of air next to my mouth first in commotion, and that pushes the next, and that pushes the next, and at length the particles next the ear are pushed and drawn forwards and backwards, and the drum of the ear is pushed and drawn back and forth, and that affects the auditory nerve, and the sound is heard. These particles, as they are set in motion, always move in straight line radiating from the source

of sound, — in a straight line between the mouth of the speaker and the ear of the listener. But under the influence of different sounds they move differently.

It is obvious that the particles may move sometimes through a short path and sometimes through a long path. Sometimes they may move a hundred times a second, and sometimes three hundred times a second over the path, so that there is a variation in the length of the path which the particle will travel over and the frequency with which it will pass. In acoustics the length of that path, or the amplitude of the vibration of the particles, corresponds to the loudness of the sound. The longer the excursion of the particle the louder is the sound. The musical pitch of the sound corresponds to the frequency with which it passes over. In the tone in which I am now speaking the particle is passing from one end of its path to the other about six hundred times a second. Under the impulse of a woman's voice, which is of higher pitch, the particle traverses the path about one thousand times a second. The number of times per second that the particle moves, or that it passes from one end of its path to the other, determines the pitch of the sound; and the length of the path which it passes over, or the amplitude of its vibration, determines the loudness of the sound. But that does not constitute articulation. You can understand a sentence which is spoken by a person whose voice is pitched at a high key or at a low key; you can understand if it is spoken in a loud tone or a gentle tone. It is neither the length of the vibration nor the frequency of the vibration, it is neither the loudness of the voice nor the pitch of the voice, which determines articulation.

What is it, then, that enables you to distinguish one word from another? In one sense, it is a mechanical process. I set in motion the particles in front of my mouth, and they go on moving and moving, and one pushing the next, and that pushing the next, until finally the one next the drum of the listener's ear pulls that drum to and fro. It is a mechanical process; I am pulling the drum of the listener's ear to and fro. Now, what kind of pulling to and fro do I impart to that drum which enables him to know by the way I pull whether I speak one sound or another? He knows the pitch of my voice by the frequency with which I pull, and he knows the loudness

of my voice by the vigor of the pull, but that alone does not help him to know what I am saying.

While the air particle passes from one end of its path to the other it is obvious that it may behave in different ways in so doing. It may start off at full speed, and may pass the whole way at full speed and stop suddenly; it may gradually increase in speed and gradually slow down again, as a pendulum does; it may start and go a little ways and go part way back again and then on. It may go in all kinds of ways. It is the character of the behavior of the particle in passing over this path which distinguishes between one sound and another sound, when both are of the same pitch and the same loudness. Your Honor readily perceives that when a particle is condemned to pass over a path *a b* of a definite length a definite number

a.....*b*

of times per second, the sound which will strike the ear will always be of the same pitch and of the same loudness; but while condemned to leave one point *a* at a certain instant and arrive at the other point *b* at another certain instant, it may behave in all kinds of ways while passing from *a* to *b*.

It is this behavior of the particle, or what we call the *form* of vibration, as distinguished from the amplitude or frequency of the vibration, which constitutes articulate sound. It is obvious, therefore, that what the sensitive plate of the transmitter must take up is not merely the same number of vibrations, not merely as many vibrations to the second as are caused by the speaker's voice, not merely vibrations whose amplitude corresponds to the loudness of the speaker's voice, but in order that it may produce articulation it must take up something which corresponds to the character of the movement of the particle in passing from one end of its path to the other. That is what is called the *form* of vibration. The form of the vibration, then, of the transmitting plate must be the same as the form of the vibration of the air particle in the air; and so, inasmuch as the transmitting plate controls the plate of the receiving instrument by means of the variations of current which pass from one to the other, as the plate of the receiving instrument obeys those variations in that current, it is obvious that what the transmitting instru-

ment must produce in the current is not merely some variations, not merely the variations which in frequency correspond to the vibrations of the air particle, but it must be a variation which in its character or in its "form," in the manner in which it behaves when passing from its maximum to its mininum, corresponds to this peculiar motion of the air.

The variety of those motions of course is infinite. It is that which constitutes what we call quality of sound; which distinguishes one person's voice from another, or the note of a flute from that of a violin or piano. It is the behavior of the particle, or what we call the form of vibration, which constitutes quality of sound, of which articulation is only one of the more advanced forms, and which enables us to distinguish one word from another. To go back to my former description, the auditory nerve takes note of the manner in which my voice pulls the drum of the listener's ear, and thus he knows what I say.

In describing these vibratory motions I have passed my finger over a long distance, that your Honor might better see there is a difference in the way in which the particle behaves. But the motion of a particle to and fro is of excessive minuteness. If it moves over a space of one ten-millionth of a centimetre, it is enough to produce an audible effect. Probably a thousandth of an inch is as much as it ever vibrates under the influence of any ordinary tone of voice. The longest vibration which has ever been produced, so far as I am aware of, on a thin telephone plate, under the influence of a voice so loud that it was just breaking into a scream and was scarcely articulate, was something like one four-hundredth of an inch. Under the influence of a woman's voice the plate vibrates to and fro over its whole path 60,000 times a minute, — 1,000 times a second. That, however, is the limit in time and space; but within that limit think what an infinite variety of changes must take place.

The behavior of the particle in passing from one end of its path to the other, — from one end of this excessively minute path, in this excessively short period of time, — must have an infinite capacity of variation; the variations must be as infinite as the sounds which the human ear is capable of hearing; and it follows, therefore, that the difference between one set of variations and another is minute beyond the power of expression, and beyond the power of any im-

agination, except the imagination of a mathematician. It is those minute variations, not the varied amplitude of the whole path, which we are to consider. Those which are important are supposed to recur at least ten times in each passage. It is obvious since that minute character is the essential thing to be reproduced in this electric current which traverses the circuit to a distant station, — it is obvious that if the successful operation of the instrument depends upon the faithful reproduction of these variations, an instrument which is to do that must have the most excessive delicacy.

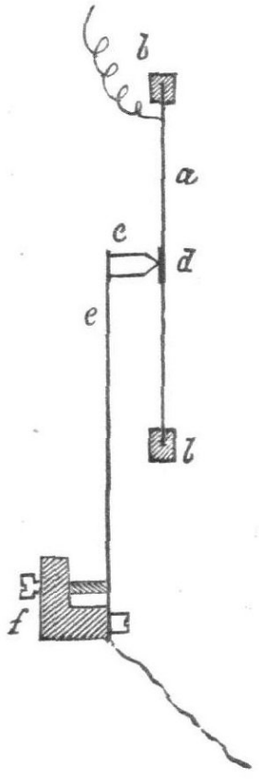
It is not the total strength of the current that works the receiver; it is the variation of the current. The total strength of the current may be one hundred, and the variation only one on one side and one on the other. But in point of fact the variations are so excessively minute, and succeed each other with such rapidity that no instrument except a telephone has ever been able even to detect their presence, and the calculations which estimate what the changes are go into figures so vast, or rather into quantities so infinitesimal, that the imagination is staggered. It is obvious, therefore, as I said, that the instruments which are to translate into electrical variations these series of air vibrations must be of excessive nicety and excessive delicacy. The rudest of them which will transmit speech at all must transcend in delicacy almost any other instrument known to science; and when you come to distinguish between them, between the coarse microphone and the delicate microphone, when you come to consider the infinite range of variation which takes place and must take place all inside of these minute limits, as infinite as the sounds which the human ear can perceive, you will observe that in order to distinguish among the infinite number of things, the largest of which is infinitesimal in size, the instrument must be excessively delicate, not only because all that operates it is minute, but because it must take note of an infinite variety of changes, each of which differs so slightly from the others that an infinitude of such differences can be packed within limits themselves almost too minute for measurement.

Inasmuch, also, as the differences which it should take note of are innumerable, and because a word may be recognizable even when much of the beauty or distinctness of articulation be lost, it is obvious that microphones which will still convey a recognizable sound

may differ from each other in perfection by a range at least as great as that between the butcher's steelyards and the balances of the analytical chemist. It is with instruments of this sort — instruments requiring this excessive delicacy — that we have to deal in this case. The critical point of this instrument is the contact between the two electrodes. There is where the work is done, and I think it is obvious, from the delicate nature of the work to be performed, that changes, which to the ordinary mechanic would appear inconsiderable, may become electrically of vital importance in the construction of the instrument — sometimes of vital importance, and sometimes seriously affecting the perfection of their performance and of the results obtained from them. And besides fidelity as to character of sound, the reproduction without loss of power is of importance: in the telephones in use in 1878, the reproduced sound was not more than one tenth of the sound of the transmitting end. It is apparent, also, inasmuch as this is the cardinal point of the whole, and as slight changes here may produce great effects in the efficiency of the machine, that the precise character of that contact, the precise form of the electrodes and the manner of mounting and supporting them and holding them in contact, is a thing that will engage the attention of inventors.

It is that which has engaged the attention of these two inventors. The articulating microphone was invented before either of them began. What they did was to go to the articulating microphone and take out some of the parts and replace them by parts of their own construction; or, more properly, to go to the articulating microphone and modify the parts which are operative at the contact so as to produce results the same in kind but better in degree; to improve, as each of them thinks, in his own direction, the apparatus. Now, it is certainly true in one sense that the instrument of the defendants, and the instrument described in the plaintiff's specification, operate in the same way. They are both speaking telephones. They both operate by the vibration which the sensitive part of the instrument takes up from the air, producing corresponding electrical variations which pass to the distant station. The whole purpose and function, the *raison d'être* of both, is to do this. They are both articu-

lating microphones. They both do it by varying the pressure at the point of contact. But when we have said that we have done nothing towards deciding the question of infringement, because we have not got to the place where the inventions of these two gentlemen began. The question is not whether one instrument is for this purpose as good as the other. The invention of the plaintiff was to modify that contact. The question is whether *that modification* of the contact in which his invention lies is found in our instrument.



Here is the instrument of Mr. Edison's application 141, which your Honor was referred to the other day. On the table before you is the instrument which was made by Prof. Morton, as conforming to that application. This plate in that exhibit, though it is a very bad one, — crumpled, almost wickedly distorted, — is still a sensitive plate. The diagram in the margin gives an idea of it. As you speak in that, as that vibrates to and fro (there is an electrode, consisting of a little carbon point, mounted on that spring), it pushes against that electrode, not enough to break contact, but enough to vary the pressure at the point of contact and vary the electrical resistance, and consequently vary the current which passes through. That is an articulating microphone. That illustrates, perhaps as well as anything, the state of the art from which they started. There is also one other instrument which shows to some extent the state of the art.

The Court. — You say this existed before either invention?

Mr. Storrow. — Yes, sir.

The Court. — What did Edison do with it?

Mr. Storrow. — He went on improving, and applied for a patent, which has not yet been granted. It has been allowed for substance, and only awaits the determination of an interference between him and a prior applicant, in order to know to whom it shall issue.

Mr. BETTS. — He never made any of those instruments except as an experiment.

Mr. STORROW. — He made the invention, and then he made some instruments to show whether they would work, and they did work; they are exhibits referred to in Edison, ans 60–62, p. 177; ans. 144, p. 180; ans. 231, p. 184; Bachellor, ans. 2, p. 184. Then in July, 1877, he applied for a patent here, and a few months afterwards he filed a specification and took out an English patent. Three months after his application for that instrument was in the Office, Mr. Irwin began his work. Mr. Irwin did not begin his work until October, 1877, three months after Mr. Edison had placed in the Office his application, and the Office had determined to allow it, reserving only the question as to whether the patent should be granted to him or to Berliner, who filed a similar application involving the same microphone principles, in the Office, a month or six weeks earlier.

We do not, therefore, state the case of a rejected and abandoned application. We state the case of one who had done all that the law required, to wit, filed in the Office an application describing an instrument so perfectly, that when Mr. Cross and Mr. Morton made one according to that description, it talked. It is allowed by the Office for substance and for form, and the patent withheld only, if I may so express myself, on a question of title. Now, if Edison had never made an instrument, it is certain that when Mr. Irwin came to the Office a year later, if he described the same instrument and stated that he did not conceive of it till three months after Mr. Edison's application was filed, he could not prevail against Mr. Edison on the face of Mr. Edison's papers, either in an interference or in the courts. And if, by oversight or sharp practice he should get out his patent first, without an interference, he would stand no better. But in truth, I do not think that Mr. Edison showed what the Office granted Irwin's patent for, as I construe his claims, and so regarding the case, I compare Edison's application with Irwin's to show that the latter can be, and according to its mere language, must be construed to be a patent for, that is for something which at most cannot exceed the difference between the two, — and so construed we do not infringe.

In addition to this Mr. Irwin testifies (p. 46), that his first work

with microphones began in October, 1877, with an instrument which is in the case as an exhibit, and which I thought was here on the table, — it was to have been here, but it does not seem to have come, — which is shown on page 46 of the complainants' record, also on page 76, of which I also have here a photograph furnished by Mr. Irwin.

You will there see an instrument which was made by one William L. Voelker (who is now in Mr. Irwin's employ) as his own invention, and brought to Mr. Irwin in October, 1877. That instrument, which they say is an articulating microphone, is what called Mr. Irwin's attention to the subject of telephones. What he did on that occasion was this. If you will observe the relation between those two, — the photograph of the instrument as Voelker brought it (p. 123), and Fig. 1, as Irwin modified it, — you will see what he did. The original instrument of Voelker had a set screw N which clamped the sharp point of the electrode in contact with the diaphragm. Mr. Irwin loosened that screw and took this wire F, which he fastened at the bottom of the post E, and ran up a straight piece of wire F to serve as a spring to press the two electrodes together, — to press D against C. What he did, therefore, was to displace the rigid point by a point carried on the spring. That was his first work. It was that instrument that he started with. That was an articulating microphone, which is an instrument which Prof. Morton and Mr. Irwin testify will talk.

The COURT. — This one?

Mr. STORROW. — Yes, sir.

The COURT. — You cannot vary the pressure.

Mr. STORROW. — You can. It is not good, but it is an instrument which can talk and will talk; so they have testified. The desired variation of contact is not to be produced by the spring, but by the vibration of the disk B, as made by Voelker; it is in the rudest typical form, which I have described. The addition of the spring is not in order to introduce the acoustic variations of pressure; it is in order to support the electrode D in such a manner that the vibrating plate can better produce the variations which it is its function to produce.

The COURT. — What is the use of mounting it on a spring?

Mr. STORROW. — Because it is better. I say that, as made by Voelker, it is a bad instrument, but they testify that it will talk. By mounting the electrode D on a spring, it will talk better, it can be adjusted better; the electrodes will be less likely to part contact; it is an improvement in the instrument.

Mr. Irwin's invention — I will call your Honor's attention to the patent in a moment — was in the nature of an improvement on an existing microphone. He did not originate a new art, as Mr. Bell did; he did not originate a new transmitter, as the first inventor of the microphone did. He improved the microphone, or sought to improve it. He introduced variations in the nature of an improvement. The law is perfectly well settled as to what such an inventor can claim. The claims which he has made in his patent are combination claims, for a combination of certain elements in a telephone transmitter. His patent is entitled at the head of it for an "Improvement in Telephone Transmitters." The law is so familiar to your Honor that I only want to call your Honor's attention to two features of it. One is that the improver cannot stop other men from improving.

The man who from an existing machine has taken out one group of elements and put others in cannot stop others from taking out the same group and putting their own work in its place. He cannot stop others because their elements are as good or better than his. He cannot stop them for the reason that their elements will accomplish the object of the machine, and perfect the machine more than his. He cannot stop their use, unless they are substantially the same thing as his, in that limited sense which constitutes identity in an improvement. And in the same way with a combination claim. A combination claim is not infringed, in the first place, unless all the elements are taken; and in the second place, it is not infringed unless each of the elements found in the defendant's machine is the same as each of the elements in the plaintiff's machine, and combined and operating in that combination in the same way. I do not mean they must be Chinese copies; but I mean the same number of elements must be found, and they must be the same elements, either identically the same things or else their representatives, their equivalents in the sense of the law and for the purposes of the claim made. They are not the same elements, because they will produce the same effect. They

must have the same attributes. Each element must have the same attributes which the patentee pointed out or made distinctive of his improvement. The elements in the defendants' machine are not the same as those in the plaintiff's combination, merely because they perform the same functions. They are not infringements of the plaintiff's combination unless each element possesses the characteristics which the complainant says his possesses, and by reason of which he introduces it.

I wish to call your Honor's attention to the patent of the plaintiff in that respect. I want to find out what it is that constitutes the plaintiff's invention. The Act of Congress declares how that is to be found out. The Act of Congress, § 4,888, declares that the patentee shall put in his patent, first, a description of his invention; next, a description of the apparatus in which he embodies the invention; next, that he shall "particularly point out and distinctly claim" the "parts or combination of parts" which he claims as his invention; and the grant which the government makes to him is the grant for that part or that combination of parts which he so points out. The phrase in the statute that "he shall point out" seems to me to be a very happy one, because we do not go to the claim for a description of invention or of the machine. That is to be given in the body of the specification. The office of a claim is to serve as a signpost to tell us what to pick out of the described elements as those which constitute the invention; and the qualifying words "particularly" and "distinctly" seem to me to have great significance; under them vague and ambiguous claims are not legal claims. The section of the statute which I refer to is this: —

"SECT. 4,888. Before any inventor or discoverer shall receive a patent for his invention or discovery, he shall make application therefor in writing to the Commissioner of Patents, and shall file in the Patent Office a written description of the same, and of the manner and process of making, constructing, compounding and using it, in such full, clear, concise and exact terms as to enable any person skilled in the art or science to which it appertains, or with which it is most clearly connected, to make, construct, compound and use the same; . . . and he shall particularly point out and distinctly claim the part, improvement or combination which he claims as his invention or discovery."

Now we are to find out what this patentee has "particularly pointed out and distinctly claimed" as his improvement, part or combination of parts. We are to find out rather, I should say, what is the improvement, part or combination, which the government has granted him the exclusive right to use in telephone transmitters. It has not granted him the right to use everything which is as good as his. It has granted him the right to use *his* described elements in his described combination, with the benefit of the rule that whatever is present by what the law recognizes as its legal representatives (whatever that may be in such cases) is present as itself.

There is another rule which goes along with that, and that is that if the patentee himself has said, "I introduce such and such a feature because it contains such an element";— if he has said such and such an element is an important feature in his invention and constitutes an integral part of his invention, then no longer is any question open to the Court as to whether that and a physically different feature in the defendant's machine are the same; if the defendant's element does not possess that feature then they are not the same, as matter of law under that patent. This arises from two reasons. First, the combination is not taken unless all its parts are taken; and "all its parts" means the same parts, what the law recognizes as the same, for the purposes of that invention. In one sense every microphone, the plaintiff's instrument and the defendants' instrument, would be, as it is commonly said, substantially the same as the instrument described in the patent of the first man who ever invented a microphone, but it does not follow that for all purposes in the law they are identical with each other.

Let us see what the courts have said on this point. I refer to a case which I am sure your Honor is familiar with, the case of Vance *v.* Campbell, 1 Black, 427, opinion by Judge Nelson, where the Court decided that when a party has obtained a patent for a special combination, the courts are not at liberty to say that some of the parts they think are immaterial and may be left out. The patent has been granted to him for that combination, composed in part of that particular element and not for a machine with that left out, and the reason the government has granted it to him is that with that particular element in, it is new, and with that out, it may not be new;

at any rate the government has not granted it to him except as composed with that part.

The same reasoning applies to a combination. All the elements must be contained, and the same elements, or the combination is not infringed; and first, for the philosophical reason which I have already referred to, and second, because that is the reason and the rule according to which patents are granted under the Act of Congress; and if a patent is granted, because the government says that while most of it is somewhere else, but precisely the whole of it, including that special element was never found before, and then the Courts say, this shall stop the defendant who does not use the whole of it, but uses most all of it, the government will grant a patent for one thing, and the Court will enforce it for another. The law and these reasons are very well stated in Burns *v.* Meyer, 100 U. S. 672.

I now want, in that view, to see if I can ascertain what it is that constitutes the invention set forth in this first patent. We sometimes, in construing a patent, like to know what has been done beforehand, — what other people have done. In one sense that has nothing to do with construction.

The government cannot grant to a patentee something which was known before, and if we find a thing was known before, we strike that out of the patent, not as a matter of construction of language, but because the government has not the power to put it there. The existence of the thing before, therefore, is looked at mainly and primarily as a limitation upon the grant, or a limitation on the validity of the grant, a limitation on the power of the grantor, not as a construction of the grant itself; but for another reason, upon the pure question of the construction of the grant, we want to look at the state of the art, — whenever we are looking at a grant made by anybody, particularly a grant of this sort, which does not grant a territory carved out of abstract space, but is a grant which occupies itself with a description of things that are known, and those that are newly invented and described in the paper which is based upon existing knowledge, — when we are attempting to discover what it is that is described in such a grant, we want first to put ourselves in the condition which was occupied by those who made the grant; and that, I take it, is what is meant by the state of the art; not to limit the patent so much as it is to know what is meant by

it, and to what the descriptive words apply. In doing that, if we find a patent the words of which can bear two meanings, the courts will strive to give to it that meaning which will cause it to stand as the Patent Office ought to have made it stand, which will cause it to stand as it is apparent the Patent Office meant that it should stand. In that view I ask your Honor's attention to the patent itself.

It begins by stating that this invention relates to acoustic telegraphy; that is to say, it relates to microphone transmitters. I have said that in the transmission of speech by telephone there is an enormous loss. The sound produced at the receiving end is excessively faint as compared with that made at the transmitting end. The various transformations — motions into electric variations, and these again into mechanical motion and sound waves — entail great waste or loss of effective power, so that about eighty or ninety per cent of the power is absorbed. Mr. Irwin's patent says: —

"The object of my improvement is to reproduce the exciting sounds without loss of volume, and thereby to render audible within a confined space sounds which in the free atmosphere would be inaudible."

That is the object of his invention, to introduce a new sensitiveness.

"To this end I construct a battery circuit with an interposed apparatus consisting of a pointed needle delicately suspended with its point in contact with another needle having a blunt point, whereby the electrical current is required to pass the attenuated part of the circuit formed by said needle points in contact and become broken up into undulations by any cause which sets up vibrations in the vicinity of said attenuated portion of the circuit."

Then he goes on and describes how his invention operates: —

When the sound waves fall upon the needles and their supporting parts they take up the appropriate motion corresponding to those sound waves, and these motions cause the desired electric variations. Neither this result, nor this general mode of operation were novel with him, but he has invented a new device which he thinks performs it very well, and the patent says: —

"My device, therefore, consists of a pointed needle suspended by an elastic support over and in pointed contact with a blunt-pointed needle."

Now he has obeyed that part of the Act of Congress which tells him to describe and state what his *invention* is. He next proceeds to obey the other part, and to describe that apparatus partly invented by him and partly by others, in which he embodies his invention, and the apparatus so described contains, and his description particularly dwells upon those features which he has already stated to constitute the essence of his invention. If your Honor will observe the described apparatus, you will see that we are going to concern ourselves chiefly with the character of the electrodes which make the contact, and with the manner in which that one of them not carried on the diaphragm (or the base which they say corresponds to the diaphragm) is supported. If your Honor will look at the instrument you will see that the contact is due to the pressure which arises from the gravity of the suspended needle. That spring which suspends it is a coiled retractile spring and tends to lift it, and the operation of that spring, as explained in the specification, is to partly lift this needle, or rather to tend to lift this needle, and diminish its effective weight. It is to be adjusted so that part of the weight of the needle shall be taken off by that spring. The pressure and stability of contact is due to the weight of that needle, partially counteracted by that spring.

It is unnecessary to observe that a contact so obtained is of great mechanical instability. It is excessively delicate, very easily disturbed, and, consequently, the slightest jar set up in the apparatus will jar and alter that contact; and, therefore, as every alteration of that contact, no matter how minute, produces an alteration of the electric current, the slightest jar will produce a sound in the distant receiver. We have therefore, by reason of the mechanical instability of the structure, great electrical sensitiveness in the apparatus to any jar produced, as by a fly walking over it, or by the sound waves of the most delicate description. We have, then, apparently, elements introduced towards the end of making a very sensitive instrument, which the patent declared to be the object of the changes devised. Your Honor will find that the patent says that the needle C is "suspended" from the cross-bar *b*, with its point resting upon the blunt-pointed needle D, and the patent, in the description of the invention, uses the word "needle" and a

"pointed needle resting upon a blunt-pointed needle." Now, when the patent uses the word "needle," and then uses the words "pointed needle," and then contrasts the point of one needle with the blunt point of another needle, it is obvious that the inventor had in his mind as the essential part of his invention that the point should be a sharp point. If you go to a man who is driving piles and ask him whether they are sharp or blunt, he will show you as his sharpest point something which for most purposes would be considered excessively blunt. When you go to a needle-maker and say you want a sharp instead of a blunt needle point, you convey a very different idea by the words "sharp" and "blunt."

It was explained in Prof. Morton's deposition that to obtain what was called a good mechanical contact requires a pressure of about one thousand pounds to the square inch. If in this instrument the pressure available is what is due to the weight of that little needle, or rather to only a small part of the weight of that little needle, it is obvious that an excessively small point is of great importance in order to get good contact. If one thousand pounds to the square inch is what is necessary to get good mechanical contact, a contact of one one-thousandth of an inch would require a pound weight. If the only weight at your disposal is a fraction of the weight of that needle, then a very small change in the area of that contact becomes notably important and goes to the essence of the instrument. It is obvious, therefore, that this inventor, in the first place, was striving to make an instrument which should be very sensitive, and in which the contact should be of the most delicate description, — should be only that due to a fraction of the weight of a needle; and in order to carry that out, not as an independent thing, — in order to carry out the same idea, to form part of the same combination to make such a limited pressure operate at all, he said that the needle was to have a sharp point, as distinguished from a blunt point. That is the description in the specification. That is of the essence of this case. The language of the patent makes it so. The nature of this instrument requires it to be so.

I now ask your Honor to turn to the claims of the patent; the first two claims are those sued on.

"1. In a telephonic transmitter, the combination, at the point of variable resistance, of a pointed needle of platinum, suspended by an elastic support and an adjustable pencil of carbon.

"2. An attenuated point in a battery circuit, composed of a freely suspended needle, the point whereof rests upon the blunt point of an opposite needle with an adjustable pressure, as set forth."

There can be no doubt that if you read those claims alone you would say attenuation was of the gist of that invention, and that the attenuation is to be obtained by the point of one needle resting upon the blunt needle. When you go back you will find in the same way in the body of the specification that it is obviously to be obtained by the use of a sharp point as contrasted with a blunt-pointed needle. We want to find out the essential elements, the assemblage of which constitutes the combination which the patent grants him the sole right to use. We want to find out what it is that this signboard points at in the body of the specification by the words "pointed needle of platinum," and what construction of instrument is signified by "suspended by an elastic support" or "freely suspended," and what is meant by "pointed needle" in the one claim, and "attenuated point in a battery circuit," composed of a needle which is to be "freely suspended," and provided with a "point" which is to "rest upon the blunt point of an opposite needle, as set forth."

I have said as much as I care to say of the statement of the invention contained in the patent. I ask your Honor now to go to the deposition of the witness for the plaintiff, Mr. Morton, the only witness called to prove infringement, and for convenience I have collected in the brief on page 23 all that part of Prof. Morton's deposition in chief which refers to the shape of the point. In the first place he said, in describing the invention of Irwin shown in the patent, and in stating whether he found it or not in the Blake transmitter, that he found in the Irwin "a sharp-pointed needle of platinum"; and then he states that he found in the Blake instrument a sharp-pointed needle of platinum. He went on, and again and again he spoke of the sharp-pointed needle.

Mr. Betts. — He does not say sharp pointed; he says "pointed."

Mr. Storrow. — I think he uses the intensifying adjective. Pages 25, 26, answer 6, he says: —

"In the operation of those instruments [the Irwin and the Blake] the production of an undulatory electric current results in both cases from variation in closeness of contact between the *sharp* platinum point and the blunt or flat carbon surface, etc. . . . *In consequence* of those similarities in structure and operation which I have described, it is my opinion that the Blake transmitter here before me contains the invention described in the Irwin patent No. 209,266, as set forth in the first two claims of the same."

Cross-int. 39, p. 35, called his attention to these phrases in the patent and in his deposition and asked him: —

"What *condition and construction* do you think is implied with reference to the needle by the terms I have referred to and by the phrase 'attenuated part'?

"*Ans.* I understand the essential feature to be a sharp point of platinum making contact with a flat or blunt surface of carbon, the attenuated part being this contact part."

So that the patent and nature of the instrument make this "sharp point" one of the "conditions of construction," and an "essential feature"; and it is *in consequence* of the alleged sharpness in the Blake that he was of opinion that it infringed.

Then he was asked more particularly, referring now back to the first patent where the two needles are described as being, one of them a "sharp-pointed" needle, and the other a "blunt-pointed" needle, — he was asked whether the needles in the two patents were the same. The first patent was for this excessive attenuation; and the second patent was not for the attenuation, but was for a combination in which those same excessively attenuated needles entered as one of those essential elements, and he says that the needles of the two patents are the same in the essential character of their points (cross-ans. 42, p. 36).

Then his attention is called to the passage in the patent sued on which describes the essential character of the patented device: "My device therefore consists of a pointed needle suspended by an elastic support over and in pointed contact with a blunt-pointed needle"; and he is asked whether "*there is a distinction between this pointed contact referred to in this passage, which would affect the working of such instruments, and the contact which would exist . . . between a blunt-pointed needle and a plane surface,*" and he answers that there is (cross-ans. 44, p. 37).

Now that runs through his whole first deposition with relation to the character of the point. Upon the question of infringement that is the case they made.

That is his view and their view, and his assertion and their assertion of what that patent means, and I submit to your Honor it is the correct view, — that it is not merely a point, it is a sharp point. May it please your Honor, it could not be otherwise. The instrument of Voelker, upon which Irwin based all his ideas, which was the foundation from which he built, had a pointed contact. The instrument of Edison had a point. Now there was no novelty in putting a point in a microphone, but there was a novelty in putting an excessively fine point.

Perhaps there is no advantage in the excessively fine point in some instruments; but if you are going to have an instrument where the pressure is to be so excessively light, then the fineness of the point becomes a material thing. Accordingly, President Morton testifies that, *in the operation of that instrument*, a fine point is materially different from a blunt point, and is the point described in the patent, and Prof. Cross testified (55 ans., p. 32) that the special sensitiveness of the Irwin instrument is due in part to this extreme attenuation.

Well, that is the whole case they made, and now, when we come to put in our evidence, we show by the testimony of Mr. Cross and Mr. Watson, and by the examination of the instrument they produce, and we admit as our instrument, that, instead of being a sharp needle point, it is a hemisphere of platinum, one twentieth of an inch in diameter. One witness aptly describes it as like the head of a large pin. (Watson, ans. 5, p. 41.)

Now, what is the answer to this? Is not that an end of that case? The patent calls for a sharp point; an attenuated point, not any point. Their expert rests his case on the presence of a sharp point, and distinguishes between a sharp point and a blunt point, and, instead of the point of a sharp needle, we have the head of a pin.

Mr. Morton is called in reply. What does he say? He says Prof. Cross is right as to the character of that point; that when he looked at it and made up his mind to testify for the plaintiff, the

light in his laboratory was bad, and so he did not see that it was not so. That is the foundation of this case. That is what they brought their suit on — on their expert's carelessness — on the bad light in his laboratory. Well, he tries to get out of it in rather a peculiar way, it seems to me, in his evidence in reply.

He confesses that he was so careless that he did not notice that it was not a point. He put his whole testimony in — and it is all they have — on the theory that it was a point, and now he finds his mistake; but he says he don't think it makes any difference. He does not say that it does not make any difference under the patent; he *does not say that the head of a pin is what is described in the specification* and adopted by the claim; he does not say that it does not make any difference in the practical operation of the instrument; he could not say that, for he had sworn that it did; but he says that he has tried an experiment which shows, he says, that *for some purposes* the two shapes are the same, not for the purposes of this instrument. One would think that after they had had to throw overboard his opinions and his observation of nature, the Court would have felt more confidence in their case if it were supported by a witness who had a better lighted laboratory, but they have called none other.

This is his experiment: He took the Blake hemisphoidal electrode and turned it down in a lathe to a conical point. He measured the *electrical resistance* of a contact of these two forms under purely arbitrary conditions, and such as never occur in practice. He found that the resistance with the hemisphere was seven units or seven and one half, and with the conical point he found that the resistance was about eight and one half or nine, a difference of ten or twenty per cent, and he said that was not much. But that has nothing to do with this case. That is not an answer to the question whether the apparatus is the same. Still less is it an answer to the question whether, when the patent turns on the presence of that peculiar point, its absence still constitutes infringement.

He tried a very curious kind of a point. The question turns on the "sharp-needle" point as distinguished from the "blunt-needle" point. Mr. Morton testified in the first place that, not trying an instrument which was in condition to transmit speech, not trying an instrument in operation, not trying to put the Blake hemisphere on

the Irwin instrument and see how that would work, but trying a test on an instrument at rest, which has nothing to do with this case, and with a great and abnormal pressure instead of the "limited pressure" of Irwin, he said he found certain results. Now what was that result? How did he do it? In his direct examination he did not tell us how he tried the experiment, and he did not say how he made his point. On cross-examination we asked him, and he said he took this hemisphere of the Blake and turned it in a lathe to a cone. That is not a very "sharp-needle point."

Having got that condition of things, which is as far from a needle point as you can find, he took a file and a piece of emery cloth and he rubbed the point until it would no longer prick the skin. Now, I submit it is trifling with the Court to pretend that the point end of a cone whose base is twice its height and which has then been rubbed with emery cloth and filed, is a "sharp-needle point," an attenuated needle point, as distinguished from a blunt-needle point. That is the whole of their case. If that attenuated needle point which is of the essence of the invention, which is essentially important, if not absolutely necessary, to the operation of his apparatus, which his patent builds upon as one of the essential features, as one of the novelties in his invention, is not present in ours, there is an end of their case.

I come now to the next element in their combination, — the "suspension." What is meant by the "suspension"? What is there in the specification which that part of the claim points us to? We have discussed the character of the points to be kept in contact. Now I want to consider the character of the supports which keep them in contact. Your Honor sees what it is that keeps them in contact in this instrument of the plaintiff. It is gravity, partly counteracted by a retractile spring. When we speak of the suspending or supporting part of that instrument, when we speak of a device which supports the electrode, we mean a device the most essential element in which is gravity, because it is only gravity which gives the contact and makes the pressure. We speak of gravity partly counteracted by a spring. When we speak, therefore, of the suspending or supporting part, we refer, and necessarily refer, to a device which contains at least the two elements of gravity and a spring; because, if either of those elements be left out, — certainly if gravity be left out, — the device becomes totally inoperative; it ceases to be a combination.

The combination, either by express recital or by intendment of law (Forbush *v.* Cook, 2 Fish. 668), must contain those parts which, in the apparatus as described, are necessary for its operation; and when the claim, not specifying what constitutes the support or the suspension, refers back to the body of the specification for it, you will find that gravity is the first and essential element; and furthermore, that the elasticity of a spring is employed to moderate it. There is no device of that kind in our instrument. Our instrument does not operate by gravity. On the contrary, if I take the Irwin instrument, where the pressure is due to gravity, and turn it upside down, the contact is broken and it will not work. If I place the plate perpendicular, as ours is, and talk to it, the first vibration will drive the needle off to the extreme limit of that vibration and there is nothing to bring it back. It can operate only so far as, and when gravity is operating: that is the essential element of the support or suspension of that needle. In our instrument we take the most scrupulous care to get gravity out of the way. We hold the diaphragm perpendicular. It is not material whether it be held with the spring fastened to the frame at its upper end or its lower end; it will work equally well in either direction (Prof. Cross, p. 25). The spring will wear out a little quicker if it is put with the weight on top. We arrange it so that gravity shall have no play at all. We obtain our pressure not by gravity; we do not employ a retractile spring; we employ a pressure spring which presses the electrodes together, and we get that peculiar kind of contact which comes from the pressure of an elastic spring.

We employ an elastic spring alone for this purpose. We do not employ the elements which are the essential and only elements in his combination, to wit, gravity, as the controlling and acting thing, partly neutralized by an adjusting spring. It is true that if you turn ours flatwise, it is possible to screw up that electrode tight and hard, so that the spring will overcome the force of gravity and work. I am inclined to think that that changes the character of the instrument; at any rate that is not our instrument; that is not what we do; that is not the way we use it; that is not the way that the inventor says it is intended to be used. He designed to use it, and the defendants do use it so as to eliminate and intentionally to elimi-

nate all gravity. That is an instrument in which gravity is not present, which carefully avoids the effect of gravity. It certainly does not use a combination or invention the essential element and operative element of which is the presence and action of gravity.

There is a recent case in the Supreme Court, Wick *v.* Ortrum, in the *Gazette* of April 5, 1881, where just that distinction was insisted on. One man made a machine for driving a gang of nails in boxes in a perpendicular direction, and he made an arrangement of springs to hold and guide the nails and let the heads go through. Another man made an arrangement for laying them flat and driving them horizontally, and he relied upon gravity to hold them; and the Court held that they were different machines; that the element of a spring which held the nails in one was replaced by the element of gravity in the other, and *vice versa*, and that they were different machines and one did not infringe the patent on the other.

I say that the essential element of the plaintiff's instrument is that the electrodes are supported and held and kept in their position by gravity. I say that from the instrument itself; from the fact it must be held in that position, and from the fact that the patent says that one is to be "suspended over" the other. I can go a little further than that. Mr. Irwin went on making further improvements in that type of instrument. He has taken out a number of patents since, — substantially all those patents that are put in the record. They began to be taken out at once; the first of them was applied for before this patent 209,256 was granted. They all of them refer to this patent now in suit, most of them in terms by its number or date, and they say that the characteristic feature of this patent is that the pressure and contact of the electrodes is secured by "gravity partly counteracted by a spring." That is his statement time and time again in his patents for improvements, as to the essential character of that instrument. Those statements are collected in the brief, p. 17, and in Prof. Cross's deposition, ans. 35, 36, pp. 26, 27.

I have referred to one characteristic of this instrument, — its sensitiveness to the slightest jar, — which comes from the mechanical structure of the peculiar support of the electrode, and from the fineness of the point. You will observe again, looking through these subsequent patents, that that sensitiveness was found to be

excessive. The very first patent that he took out after this, applied for before this patent was issued, was for casing the whole instrument in a jacket of felt or cork, because it was so sensitive that any sound in the room disturbed its transmission. Then he packed the instrument in cotton wool, putting the box which contained the instrument in another box with cotton wool, and he packed it with soft rubber and all kinds of things. Not succeeding in getting rid of the sensitiveness of the contact due to that mode of support, he sought, not to alter the sensitiveness of the contact, which he could not do so long as he retained that character of support, but he sought to protect the instrument from all sounds except those that were intended to fall upon it. These references are in the brief, p. 20, and in Prof. Cross's deposition, pp. 32–35. That is the result due to the form of construction that he employed. He employed that construction, he says, to get great sensitiveness. He has got it, — a little too much. Our instrument does not have that sensitiveness. We have put it in practical use in thousands of instances, and it needs no such protection.

I think your Honor must see that these two instruments belong to two different types, one the spring-pressure type and the other the gravity type. Mr. Irwin recites the history of his invention, and if we trace that history we shall find that that distinction of type not only has been stated in his subsequent patents, but ran through his whole invention. I ask your Honor's attention to the drawings which they have put into the case, which show his invention. If you begin with the defendants' record, at page 47, you will find that the first thing that he did there was to take the instrument with the pointed electrode of Mr. Voelker and apply to it, not gravity, but a spring to keep them in contact. There was a spring-pressure instrument undoubtedly. Now if you will turn over to the next drawing, Fig. 2, you will find there a more finished instrument, of which this [*referring to an instrument produced as "Exhibit H," p. 79, of complainant's record*] is, I think, not the original one, but another one made about the same time. There your Honor will observe the pressure is obtained by a spring which presses the electrodes together with a tension regulated by an adjusting screw.

There is no gravity there. That is an instrument which can be held in any position. At the next instrument he begins to branch

off. There you get the contact by gravity alleviated by a spring partly counteracted by a spring. I should say, before going on, that Mr. Irwin testifies that Fig. 1, the Voelker instrument, although he first testified that it was entirely destroyed, on cross examination it was brought to his mind that a year ago, in another proceeding, that instrument had been produced and he had sworn that it was the same instrument, unchanged from the way he used it. That was brought out on his cross examination. His memory seems to have been treacherous. It was not a misstatement which helped him any, but it is simply that he has got a worthless memory. Finally, on further cross examination, it appeared that the instrument had been broken up and the parts collected and put together to be used in evidence (pp. 76–83).

We come to the next one, Fig. 2. He testifies that that was entirely destroyed; that the parts were destroyed a few weeks after it was made; it was broken up, and the parts used to make other instruments. So that No. 2 is destroyed and does not exist, and all the parts of No. 1 which embody his invention have been taken off and destroyed. His testimony about that, that he never had another one like it that continued to exist, also exhibits the same peculiar want of memory, as your Honor will notice from the cross examination. A duplicate does exist; but a year ago he swore to it as the invention of another man.

We next come to Fig. 3, which shows pressure due to gravity. That is an instrument of the gravity type.

We next come to Fig. 4, which is the spring-pressure type. That is a little Rhumkorff coil, used for other purposes. The coil exists, although the operative parts which contained his supposed invention have been taken off and destroyed.

We next come to Fig. 5, which is an instrument of the gravity type.

Fig. 6 is again of the gravity type, — very nearly his patent.

Fig. 7 is again of the gravity type.

Fig. 8 is of the gravity type. He testifies that at one time, when the instrument was first made, he used a compression spring that operated to keep them together, and afterwards that spring was taken off and changed, and the spring which is now in the instrument is a

retractile spring which operates to differentiate, as they say in one of the patents, or to diminish the force of gravity.

Mr. BETTS. — You are mistaken about that. There is no evidence of that kind. Fig. 8 is described in the middle of page 55.

Mr. STORROW. — I will read that. The instrument itself is in evidence, but is not brought here as it should be. If they will produce it you will see that it has a retractile spring, and the moment you turn it upside down the electrodes fly apart and it ceases to operate.

We go on now to Fig. 9, an instrument which was not made until 1879, long after Mr. Blake's instrument was in public use. They testify that an instrument "something like it" was made before, but it no longer exists.

Fig. 10 is the instrument which is before you. That has a pressure spring. But they testify that that instrument does not embody the invention sued on under the first patent.

Irwin says, p. 68 : —

"*Cross-Int.* 62. Do all the drawings you have produced, Nos. 1 to 11, embody the invention set forth in your patent 209,266, and referred to in the first two claims thereof?

"*Ans.* All with the exception of Figs. 2, 4 and 10."

Mr. Morton says, p. 99 : —

"*Cross-Int.* 19. You say that the instrument marked 'Exhibit Irwin Instrument No. 10' contains the invention described in the patent No. 225,388 ; does it also in your judgment embrace the invention specified in the first and second claims of the Irwin patent No. 209,266 ?

"*Ans.* It does not."

Irwin's testimony about these instruments is, that they were all made and tried in the first half of 1878, — February, March, April, May and so on. In June, July and August, 1878, Mr. Irwin began to take out patents.

I should observe about Mr. Irwin, that he is, if I may use the expression, a professional patentee. He says that he has taken out about a hundred patents for inventions, chiefly his own. He is a man of large means, familiar, of course, with patents and the manner of taking them out, and he has a great experimental laboratory and machine shop of his own near Philadelphia. Nothing would stop

him from taking out patents or from pushing experiments and perfecting inventions in any line of invention which he thought would lead to good results, and he says that he took up telephones because he thought there was money to be made on them. We find then, that, having first experimented and made two or three instruments, one of which, Fig. 2, was a tolerably finished instrument of the spring pressure type, he abandoned that type, broke up, or supposed he had broken up, all the instruments which contained it, and devoted his attention to making instrument after instrument of the gravity type. Then he took out his patents, and he described in them the gravity type and none other. He took out patent after patent — still of the gravity type and none other — for improvements on his first one.

In November, 1878, the Blake instrument was by Mr. Blake and his licensee, the Bell Telephone Company, introduced into commercial use. It met with great success. By the last of May, 1879, there were 5,000 of them in commercial use under license from him. Then Mr. Irwin, finding that his instrument (I think the evidence will show you) was of itself of no practical value, for only four of them have ever been made, conceived the idea that he would dig up these old forgotten things of his about spring pressure, and see if he could not jump on the Blake instrument and seize it; and so in the last week of May, 1879, he filed an application for a spring-pressure contact. That was immediately thrown into interference with Mr. Blake; it was immediately thrown into interference with the application of Mr. Edison, No. 141, already mentioned, which had been pending in the Office on another interference since July, 1877, three months before Mr. Irwin turned his attention to the telephone. When he saw that he had got to compete with an application which showed an operative instrument, an application filed in the Office three months before he began the subject, he knew that he would make nothing on that, that he would be beaten in that interference; so that the next thing he did, in August of that year, was to get his assistant, Mr. Voelker, to allow him to draw an application in Voelker's name, for Voelker, as the first and original inventor of the spring-contact telephone; and he filed that application, and that was thrown into interference, of course, with Mr. Blake, with Mr.

Irwin himself, and with that instrument of Mr. Edison (Voelker, cross-ans. 14–26, plaintiff's record, pp. 129–131).

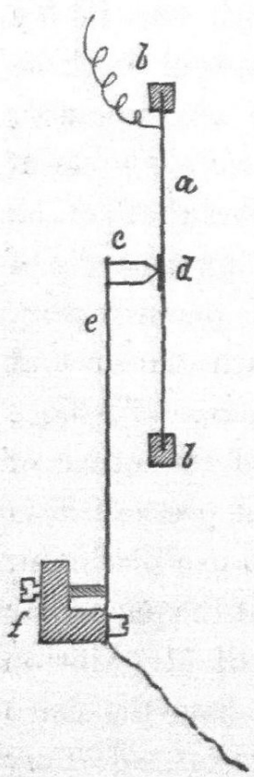
The evidence was taken in that interference, and part of it is incorporated in this case. (Plaintiff's record, pp. 81, 121.) Things went on, and finally it seems to have occurred to these gentlemen that after all, perhaps their best chance was not to go to the Patent Office, but to come to your Honor and ask your Honor to find that the spring-pressure type which they had discarded, making two or three little instruments in the beginning of 1878, and breaking them up,— the distinction of which from the gravity type they have shown — it occurred to them that if they could come to your Honor and with the aid of experts could say after all there was not any difference between those instruments, then they had got possession of and could get the profits of the Blake transmitter, — a slim chance indeed (except in a badly lighted laboratory), but the prize was large enough to base a speculation on. That was the conclusion they came to, and that is what has brought them here. They never said a word privately or publicly about spring-pressure telephones, they never did a thing on a spring-contact telephone, except to break up those they had made, until Mr. Blake had got his 5,000 instruments in successful commercial use.

They make also a point, in my brother's argument, and in the deposition of Mr. Morton, on the subject of the material of these electrodes. Well, in the legal sense that is of no consequence. Their claim is for a combination, and if any one of those elements of their combination is not present in ours it is no matter whether the others are. Their claim is for a combination of a platinum needle of a peculiarly shaped point, suspended or supported in a peculiar way, with an adjustable pencil of carbon. They try to turn that around as if it was a claim for the use of two electrodes, the one of which, having any kind of a point, should be of platinum, and the other of which should be a flat surface of carbon. They do not pretend it is new to use carbon; they do not pretend it is new to use platinum, nor even to use the two in contact in a telephone; but the particular advantage, which they refer to in the expert deposition of Mr. Morton and the deposition of Mr. Irwin, is that it is better to have the sharp one made of platinum, because it is of more durable material. If they had a claim for that, would it be valid? Is there any invention in that?

Everybody knows that for a long time electric contact points have been made of platinum because it is a material which will not oxidize; and when it is known in the art that platinum and carbon are good materials for telephone contacts, is there any invention, when you are told that one electrode is to be sharp, in sharpening the harder and more durable of these two materials, instead of the friable and brittle one? If, therefore, they had a claim for making the sharp one of platinum, as distinguished from carbon, it would be a claim which would lack invention to support it.

They have started one other theory, which at least has the merit of ingenuity in the expert. They say that one essential element in the operation of their instrument is the inertia of the needle; that it is this inertia which enables the pressure between the two to be varied; and they undertake to treat that patent as if they had got squarely a claim for inertia; or, rather, they began to do that; they have changed their ground somewhat.

The nature of their pretensions in this respect can best be understood by comparing their patent with the state of the art of which the Edison instrument is a good illustration. We repeat in the margin a diagram indicating the operative parts of the Edison microphone. The diaphragm *a* is supported in the frame *b*. The pointed carbon electrode *c* makes contact with the platinum electrode *d*. This pointed electrode *c* is carried on a spring *e* provided with a tension adjusting screw. Mr. Edison's specification (p. 97) does not state the size or stiffness of the spring, but it is evident that its tension is to be such as to give a suitable normal pressure, because a tension screw is provided to adjust it. It is described as a spring, and it is therefore to be springy with reference to the parts and forces to the action of which it is exposed. It is only acted upon by the diaphragm, either when the latter shifts its position as the frame warps, etc., or as it vibrates under the influence of sound waves, and therefore *ex vi termini* its stiffness or slimness as compared with the particular



diaphragm employed must be such that it will be the more yielding of the two.

When sound waves push the diaphragm toward *c* the electrode *d* presses against *c* and its supporting parts; it tends to move them and it requires some force to do that. The diaphragm so moving encounters some physical resistance, and in overcoming that resistance the pressure increases at the point of contact. As the diaphragm swings back, the electrode does not swing back so rapidly on account of its indisposition to move, and therefore the pressure is lighter at the point of contact. What causes that? There are two causes undoubtedly present. If that be a spring held under a certain pressure like this ivory paper cutter I hold in my hand [*illustrating*], and I push it over that way by pressing my finger against the free end, the strain or the pressure on my finger will increase. At the present time the pressure on my finger is due to the strain of this elastic spring. If I push it over further the strain is increased, because the spring is brought to a greater tension and the pressure is increased. What works the microphone is not pressure, but it is variation of pressure. What causes the increase of pressure on my finger is not the pressure there when I start, but it is the difference between the pressure at that point and the pressure at this point when I have pushed the spring further over by my finger.

It is obvious that that difference of pressure is due to the greater strain, to the *increase* in the strain of the spring, and that depends partly on the distance that I move my finger through and partly on the length of the spring. It depends, in other words, upon the angle (considering the point where one end of the spring is fastened as a centre) or the arc which the end of the spring, or the point of contact moves through around that centre. The angle depends of course upon the radius and the distance that the point moves through. If the radius be very long, as compared with that distance, of course the increase of pressure is very inconsiderable. That is what takes place in that instrument. The spring there shown is an inch and a half or two inches long. The vibrations of a diaphragm are motions of excessive minuteness. What is the length of each of the varying vibrations of an instrument, all of which occur eight or ten times in

a total path of one ten thousandth of an inch? The *increase* of pressure due to the springiness of the support is therefore quite inconsiderable. On the other hand, there is another thing that resists that motion and causes increase of pressure, and that is the inertia, or the indisposition of these parts to move, and by "parts" I refer not merely to the electrodes, but the whole system composed of the spring, the electrodes and all the parts connected with that back electrode which are compelled to move. It is an indisposition to change its condition of rest or motion. That indisposition to change, that inertia, depends not upon the distance it is to move through, because it is an indisposition to change its motion or rate of motion, and when you have got it started the inertia does not interpose itself as an obstacle to a continuance at the same rate, but only as a resistance to any change in the motion. Inertia is a function or result of two elements, the speed with which the body is required to change or the rapidity of the motion which it is required to suddenly take up, and the mass which is to be moved; the element of rapidity enters by its square, that is to say, the inertia is the square of the speed required to be taken up multiplied into the mass.

If, therefore, you have, as in the telephone, a motion you expose it to, which, although of small extent, is of enormous rapidity, and varying at infinitessimal intervals, you readily see that you get a considerable amount of inertia, although the mass is small, because the rapidity enters by its square. Moreover, it is obviously true, and not contradicted by the other side, that inertia is present in Edison's instrument. Mr. Morton thinks that it is not "efficiently" present, but the considerations that I have referred to show that it is present as a substantial element. Mr. Cross (16 ans., p. 22) testifies that it is. This, therefore, leaves the case in the following condition: Mr. Irwin was not the first to use inertia. Mr. Morton says Mr. Irwin *efficiently* employs it, and Edison does not employ it so efficiently; that is, he wants to treat the Irwin patent as a patent for the *efficient* employment of inertia, and he says that Irwin employs inertia efficiently by giving to his electrode, which is to be moved, considerable mass, giving it "a notable mass." Does he? Is there anything of that sort in the patent? Is it a patent for the efficient employment of inertia? Is it a patent in which the

parts are designedly and intentionally arranged, in which the constructor is told to arrange the parts so as to develop inertia? There is not a word on the subject in the patent, not a word on the subject of inertia, nothing to indicate that the idea was ever in the inventor's head. More than that, the directions given in the patent to the workman are such as are inconsistent with the existence of such an idea.

The efficient employment of inertia would depend upon the mass of the needle, — the weight of the needle. The patent says nothing about its size, except that it is "a needle," which certainly does not imply a large mass. If size were essential, he would have said so. It is not the bulk of the needle that is important in this view; it is the weight of the needle that causes the inertia. Now the patent says, so far as the operation of the instrument is concerned, it is of no consequence what material you use; but durability and the requisite sensitiveness make platinum or carbon necessary. Platinum is about three times as heavy as iron, and is about ten times as heavy as carbon. Is that a patent for the efficient utilization of inertia? Is it a direction to the workman to give weight to the electrode when he says nothing about size or weight, and says that it may be indifferently of the heaviest material known to the arts or one of the lightest? More than that, Mr. Irwin was examined on his own behalf, and he stated the history of his invention, and in his history of his invention there is not one word said on the subject of inertia, not one word said to indicate that the idea ever entered into his mind. On the contrary, it is clear from his patent that he did not contemplate that condition of things which the Blake structure presents, and which enabled Mr. Blake to employ inertia so effectively.

In the Blake all the sound waves fall upon the plate alone, which takes up that kind of motion which characterizes thin plates, and all the motion which the anvil electrode is asked to take up is what is brought to it second hand. The Irwin patent, on the other hand, says that the instrument is to be operated by "sound waves falling upon the above-mentioned *needles* and their supporting parts," and by reference to the former patent and the structure of the instrument, Prof. Morton shows us correctly that the vibrations in the Irwin instrument are what he calls the "sonorous vibrations of a rigid body."

A little reflection will therefore show your Honor, that while the Blake at once suggests the rapid blows of a hammer on its anvil, — the sharp, quick blows given by the fist of the boxer to a suspended sand bag, and the resistance of that mass, — nothing in the Irwin suggests this picking up of motion by one part, and its transfer to the other, but indicates an apparatus, all parts of which pick up the same sound wave, and through the whole body of which sonorous waves pass. Undoubtedly inertia plays its part in this just as it does in the propagation of sound waves through the air, but it needed the astuteness of a trained expert, reflecting in the quiet of his badly lighted laboratory, to find it here.

Now if you look at the instrument invented by Mr. Blake and put into public use in 1878; if you look at the specification which Mr. Blake filed in the Patent Office on the 3d of January, 1879, and which, of course, Mr. Irwin is familiar with, you will see that that is a contrivance for the efficient utilization of inertia. It calls attention to the mass to be given to that electrode, and to the employment of inertia thereby; and with this before him it is very easy for Mr. Morton to find in this patent what no one ever found there before; it is very easy for him to find in the apparatus described in the patent, when he reads it in the light of what Mr. Blake has done, something that neither the inventor himself nor any other human being pretends he ever saw there until they had seen the success which had followed Mr. Blake's invention and Mr. Blake's ideas.

There are one or two authorities which I wish to call your Honor's attention to, because they seem to me to have a direct bearing on this case. In the case of the Swain Turbine Wheel (11 O. G. 153), which was before Judge Shepley, and which was afterwards affirmed in the Supreme Court, Judge Shepley, in discussing that beautiful instrument, the turbine, said that in an instrument of that delicate class form was everything; the form of the bucket, the manner in which the water was shot upon it, or conducted or brought to it and supported in its passage to it, was of the essence of the invention, and a variation of form which in building a house or in other things would be immaterial, was enough to constitute on the one hand a patentable difference if it was advantageous, while a departure from which would be enough on the other hand to destroy the identity of

the invention. What is true of a turbine wheel is certainly true of this inconceivable delicate instrument, where the object of the invention was not merely to make an instrument which would transmit speech, for that had been done before, but to make one which would be more delicate than anything that had preceded it.

In the case of Rich *v.* Close (8 Blatch. 43), Judge Woodruff stated what is a very good test of infringement in claims of this character. He says, to answer the question whether the defendant's instrument infringes the plaintiff's claim, it is right to take it the other way and inquire would the pre-existence of the defendant's instrument have destroyed the plaintiff's claim? If it is not the same to destroy it, it is not the same to infringe it. If the defendant's instrument has not got the invention there so that it would not destroy it, it has not got the invention there to infringe. Look at the Blake. Suppose when Mr. Irwin went to the Patent Office with this application the Blake instrument had been there, and had been in public use and they said, "We will reject you on the Blake." He would say, "No; Mr. Blake has not got a sharp-pointed needle in contact with a blunt needle. Mr. Blake has not got a support in which gravity is the essential element. He has not got the elements in combination like that. He has not got my elements. He has not got my combination."

So when Mr. Irwin went to the Office the Office had before them that instrument of Edison's. An interference was pending on those very parts of that instrument, and if the Office had said to him, "Look here, there is a point; there is a spring in the supporting part," he would have said, "That is not my point. I have sharpened my point, and I think that is a patentable difference." He would have said, "That is not my spring. I do not make the contact with a spring pressure; I make it with gravity alleviated by a spring. My spring pulls away, it does not pull towards," and he would have had his patent. Precisely that thing did take place at the Office on one occasion, as you will see from the extracts from the files of the Office which are in the case. (Official letter of Jan. 7, 1880, p. 89.)

IRWIN'S PATENT 225,388, MARCH 9, 1880.

I come now to the second patent. The claim sued on is this: —

"In a telephone, a sensitive vibrating disk G, having free edges and capable of vibrating bodily, combined with electrodes maintained in contact."

The history of that patent is to be noted carefully. In November, 1878, Mr. Blake put his instrument into commercial use. It had the same diaphragm that is in it now. On Jan. 3, 1879, he applied for a patent, by an application which is in this case, and which describes the feature which they say constitutes the infringement, and he made a claim to his particular way, or rather to the particular addition he made, of holding a diaphragm; that is, springs peculiarly arranged to hold it. That peculiarity of holding it by springs has nothing to do with this case, but I allude to that to show that he drew the attention of the Office to his diaphragm. Five months after that was done, and after Mr. Blake had five thousand of these in use, Mr. Irwin comes forward and he files on the 24th of May, 1879, an application for a patent which is substantially the application on which this patent is granted. It contains exactly the same description of diaphragm and substantially the same claims as that now in suit, made for the first time after Mr. Blake, for months and months, had had his instrument in extensive commercial use. In that same application, for the first time, he showed a pressure spring to carry one electrode and to create the pressure, and made a claim accordingly, and the Office put him into interference with Mr. Blake. That is to say, they adjudged that the spring pressure was what it interfered with; they found no interference in the manner of holding the diaphragm. Although both of these parties had called attention to their respective constructions as important features of their instruments, the Office saw no interference there and adjudged that there was none. That spring-pressure interference (No. 1) went on. In December, 1879, Mr. Irwin asked leave of the Office to divide his application of the previous May in order that he might obtain a patent for the matter that did not interfere. The Office granted that. He struck out of his first application, under that permission, all that related to the diaphragm and put that in a new

application, which he filed on the same day (Dec. 19, 1879), and on that this second patent in suit is issued (record, pp. 83, 147).

Now we are sued on a patent which the plaintiff did not apply for until five months after our instrument had gone into extensive commercial use. We are sued on a patent which he got out of the Office on the explicit statement that there was no interfering matter. We are sued on a patent which the Office had no business to give him, except upon the ground (and I think the Office was right in finding that there was no interference) that nothing in that claim controlled or interfered with the use of our instrument. We were the first in the Office with an application. That is the patent we are sued on, and that is the kind of a case these gentlemen have brought before your Honor.

There are two answers to that claim, or three. One is that Mr. Blake made his instrument before Mr. Irwin thought of the device which is covered by his claim. Mr. Blake was first in the Office, and he had it in extensive commercial use when Mr. Irwin applied. There is no record or written date of Mr. Irwin that goes near Mr. Blake's public use. Mr. Irwin undertakes to date back to the spring of 1878, by his own unaided and unsupported testimony; and how does he do it? He says he made some instruments in which he occasionally laid the diaphragm on the top of the microphone, and let it stay there by gravity, and in that condition the edges were free. None of those exist; he does not produce them; he does not produce a human being who ever saw them. It is his *ipse dixit* that he once made one of those instruments. When? In the spring of 1878. Did he follow it up, or was it a thing chucked into a scrap heap, so that even he now cannot find it? Then he refers to that one before your Honor (No. 10), and says that embodies the invention. Is that our diaphragm? Is that the diaphragm of his second patent? And that rests on his unsupported testimony. He has called as witnesses, besides himself, Mr. Voelker, who assists him in all his experiments, and one or two other persons from his laboratory. He does not ask one of them a question as to the date of that crude, mechanical sketch (No. 10), worthless as a practical instrument (so Mr. Morton and Mr. Irwin testify), and he has the assurance to bring that forward to support an application made months after we have got our

instrument into successful operation, and he expects your Honor to grant him a decree on that alone.

You remember what kind of a witness he is. He swears that that these things (Nos. 1 and 2) were broken up. A year ago he produced them and swore that they had never been changed, and finally on cross examination he swore they had been broken up, and the parts were dug up and put together again to be used as evidence for the interference a year ago. Is that the kind of thing to control the instrument of Mr. Blake, for which Mr. Blake would have had his patent long before this if it had not been that there were various contestants as to other features and other parts of it?

I go further than that. I do not care how many people Mr. Irwin had brought to sustain his proposition of fact, Mr. Blake's apparatus was put into commercial use in November, 1878. Mr. Irwin must go back of that with a finished instrument, — with a finished idea if he is going to do anything. Now look at his patent No. 223,352, which is a patent applied for Jan. 1, 1879; he must prove his invention back of that. The instrument of 209,266 does not use any diaphragm in the plate, it uses a sonorous plate. In this patent, applied for in January, 1879, after our instrument had been a couple of months in commercial use, he for the first time showed a diaphragm. The patent was for the introduction of a diaphragm into that instrument. That was the sole claim. The law required him to, and there is no doubt that a professional patentee, who has been taking out patents all his life, would take pains to describe the best way of holding that diaphragm, and he there says expressly that it should be held by the edges. Not a word there about free edges. That patent concerned itself with nothing but to state his latest improvement relating to diaphragms. He introduced a diaphragm and took out a patent for introducing a metal diaphragm into his instrument, and he says that it should be held at one or more of the edges, and you will see by the drawing that it is a diaphragm held all the way around. Now, does he expect by any amount of swearing to coax your Honor to believe that, before that, he perceived that the true way to use a diaphragm was *not* to support it at the edges. Does he expect your Honor to believe *that* on his own unsupported testimony, stimulated by the prize that is before him,

with nothing to support him but that little mechanical sketch, not daring to ask the question of a single one of his employés to support it? Of course not.

I want to say a word, and I will only say a word, upon the question of what constitutes "bodily motion," as that phrase is used in that patent. I am not trying to find out what the phrase could be used to describe, but what it does describe in this patent. The claim is for a diaphragm having free edges and capable of bodily motion; "capable of vibrating bodily, combined with electrodes maintained in contact." Prof Morton's testimony — he was the only witness to prove infringement — is collected on pages 52 and 53 of our brief. I will not stop to read it, but will state it. He was asked to define what that "bodily motion" was, and he defined it very carefully, with great skill, stating that it meant a motion of the diaphragm when it did not flex at all; not supported at the edges and flexing at the middle, but so moved that it should always be in parallelism to its original plane. The edges were to move as much as the centre, and the centre no more than the edges. It was not to bend at all, and he said the object of that was to get rid of the strains, — which in the patent are called "buckling," — the strains which are produced when it is flexed, — and the idea is, that those strains which are induced in flexing prevent that freedom which is desirable in an instrument of this character. He went through that, time and again, in his first deposition. Then when we came to the deposition of Prof. Cross, it was proved by Prof. Cross as a thing too obvious to be denied, that there was no such "bodily vibration" in our transmitter. In our Blake instrument the diaphragm is not free to so move. In the first place, when the wave of rarefaction strikes that side where the mouthpiece is, it tends to push that diaphragm, and the movement is resisted by that brass clamp C′, and by that spring C.

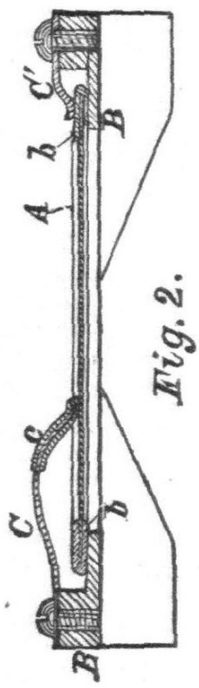


Fig. 2.

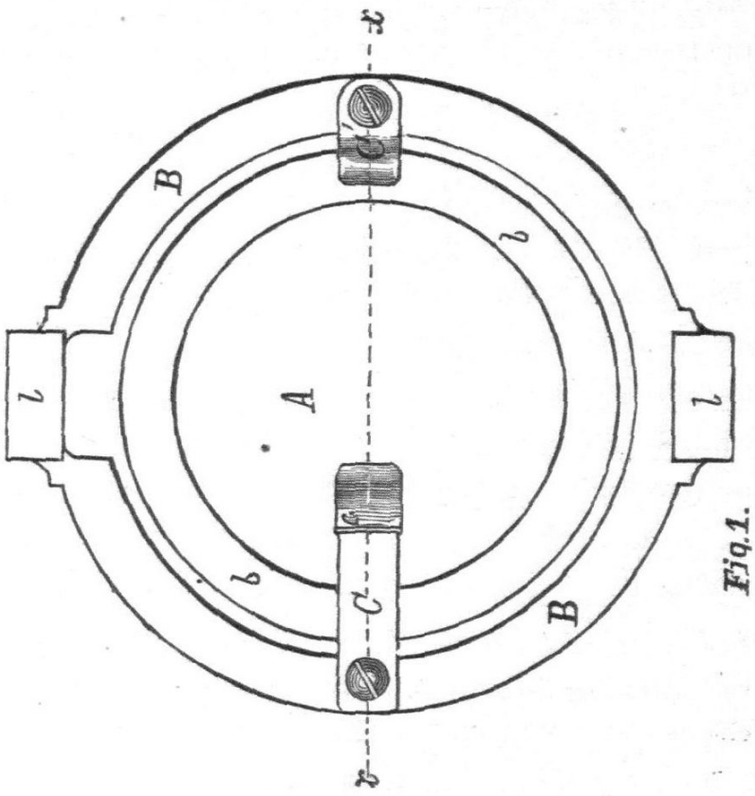


Fig. 1.

When the wave of rarefaction brings it back, it is resisted by the supporting frame all about it, and it bends in the middle. Mr. Cross testifies that it is so, and Mr. Watson testifies that it is so. They undertook to mystify Mr. Watson a little, or, rather, they undertook to use an unhappy word in a double sense. The patent used the word "buckling." Buckling is a very vague and indefinite word, understood in many senses. Mr. Morton describes what he understood the word buckling to mean *in that patent;* that is, that it means any flexing or bulging of the diaphragm. Mr. Watson, speaking not with reference to this patent, but as to the general meaning of the word, understands by "buckling," trouble which arises in saw plates when they are cooled or heated unequally, and stricture takes place around the edges; that is, a strain which exists when a plate is at rest. Now, strains which go into saw plates when at rest and which go into a telephone instrument because the supports warp and twist, is what Mr. Watson describes by "buckling," and he says *in that sense* the Blake diaphragm does not buckle; but when you use buckle in the sense which Mr. Morton says it means in the patent, that is, bending under the influence of sound waves,

Mr. Watson says that the plate of the Blake transmitter does bend. Mr. Morton again in reply was invited to explain what he meant. He could not deny what he meant by bodily movement, for he had said squarely what it was. He now says if it did not have bodily movement in that sense, it moved somewhat; that when he said it moved in parallelism he did not mean that it moved in parallelism, but it did not bend so much as it otherwise would.

Mr. Morton's testimony in putting in his case was exactly correct as to what bodily motion was in the patent, and its correctness is shown in the records of the Office; for in the letter of the applicant to the Office asking for that patent, when he is referred to a precedent or reference as a ground for refusing that claim, he says, that in his application the plate moves bodily; that is to say, the plate always moves in exact parallelism with itself,— "a disk unclamped at its edges so that it may move bodily *or with its surface in parallelism*" (p. 90 at top). That is the ground upon which he got his patent; that is what Prof. Morton said he believed to be the patent. Now, instructed by the necessities of their case, he says that as a whole, perhaps, it moves a little, and suggests that if it does not have that bodily motion — but some motion of a different character, which is not very different — it may still come within that claim.

There is one other answer to that claim; and that is, that the real thing in Mr. Blake's invention is putting a soft rubber washer upon the diaphragm and a hard metal ring. There are two purposes for it. The one is that the warping of the support, the bending of the support so as to warp and twist, tends to induce abnormal, permanent strain in the plate, and this construction avoids that difficulty. The other is that they may act as dampers. The sound vibrations that strike the plate vary from instant to instant. If we take a drum or plate and strike it a blow with a hammer, it will set up a rate of vibration, and continue that rate of vibration until it gradually dies away. If, having allowed it to vibrate for one ten thousandth part of a second, we want to change its rate, we have got to stop it first and then start it at a different rate. If you press against the diaphragm a soft material, such as a rubber washer, you damp it down, and you stop those prolonged or natural vibrations, and make it incapable of responding to anything except what are called forced vibrations

impressed upon it by the air. That is the only part of our device which they complain of. It is shown in the patents of Gray, Phelps and Dolbear, applications for which were filed in the Office long before Mr. Irwin pretends that he made this invention.

They have to concede all that; they concede now, and I understand my brother Betts to concede, at any rate their evidence does, that so far as the operation of the plate itself is concerned, so far as the fidelity with which the plate itself takes up the vibrations, there is nothing in their claim or in our apparatus in that respect except what is old. They say, "But this is a battery telephone, and it was a new invention to apply a dampened disk to a contact telephone after you had once used it in a magneto telephone." Why? What was new in it? What was needed to be added to this device to make it work as well in one as in the other? Mr. Morton says that although undoubtedly it is in fact the same; although undoubtedly the use in the one instrument would suggest the use in the other, one could not be sure until one had tried it that it would succeed in the second as in the first. Is that all that is necessary to constitute patentability? Does the solution of a possible doubt (if there were such a possibility) by the mere trial of an old device unchanged in an analogous place, and for the same purpose, constitute invention? He does not suggest that any new method or contrivance or device was necessary. He says you could not be sure that it would succeed; try it, — it does. Could there be any doubt either that it would succeed? His statement is that in the magneto instrument there is a pressure to hold the plate; that it was used in the Gray and the Phelps and the Dolbear and others by putting a washer of paper or felt or india rubber or thick blotting paper, and then laying this diaphragm on [*illustrating*], and sometimes another washer and then sometimes bringing this cap down on it. They say it is held there by the attraction of the magnet, which acts like a pressure, and that there is no such pressure in ours. But there is; there it is. It is effected in ours by the long spring C, the heavy spring covered with rubber at the end and the short brass clamp C′. The soft rubber at the end prevents prolonged vibration. They say it required invention having that in the magneto to apply it to a microphone, because that pressure

is necessary, and the microphone does not offer any equivalent. Why, the thing upon which Mr. Irwin undertakes to antedate Mr. Blake is that in a microphone he had taken the plate and laid it on and let it stay there by gravity alone (ans. 29, p. 60). Will your Honor undertake to say it required contrivance and invention when he says that all he did was to lay it on and let it stay there?

I have referred to various statements of Mr. Irwin outside of his deposition proper. I suppose them to be competent. Our grounds for so believing were stated on page 29 of our brief, and to the cases there cited should be added Legett *v.* Avery, 101 U. S. 259, cited on page 52 of our brief.

ARGUMENT OF CHAUNCEY SMITH, ESQ.

May it please your Honor: The invention of the telephone has made it necessary for scientific men, for practical men, for experts, and for judges to consider a class of facts which have not ordinarily been brought under their consideration, and to consider especially forces, the minuteness of which the imagination can scarcely grasp, and differences between these forces, which, infininitely small as the forces themselves are, must be considered with reference to their being greater or smaller than each other. All the phenomena of sound rest upon just those differences between things which are each infinitely small. It is, therefore, necessary to be careful in considering any apparatus dealing with the phenomena of sound, that we are not misled by the common acceptation and meaning of words as applied to common things; that if we are called upon to consider differences of degree, we must remember that they are differences in degree between things of a character where differences become important which would ordinarily be of no account whatever as applied to common things.

I speak now without much effort; the amount of force which I expend is very small as compared with what I am capable perhaps of exerting in other ways, but my voice reaches every part of this room. It falls upon the organ of hearing of a few individuals and upon the walls of the room. Every cubic yard of air in this room weighs about two pounds. If your Honor can estimate the number of cubic yards, and multiply it by two, we shall have the number of pounds of air in this room. And yet the little force that my voice exerts puts the whole of it in motion, moves every particle of it, — to an infinitely small extent indeed. Of this, a small amount of force falls upon your Honor's ear and gives rise to the phenomena of sound, not merely because the force falls there, but because it is infinitely varied in falling there, small as it is.

I shall refer for one moment to an illustration of one fact in relation to the phenomena of sound, although my associate, I think, explained the matter fully; but inasmuch as these alleged inventions relate peculiarly to the phenomena to which I am now to call your Honor's attention, I shall beg your pardon for referring to that again. We all know that sounds differ from each other in their loudness. We know, too, that there is a difference called the difference in pitch. It is one of the differences between the common male voice and the female voice. It has long been known that the difference in loudness depended upon the amount of force with which the air was put in motion and the extent of the vibration of the particles to and fro, so that they struck the drum of the ear with greater or less force, and struck it with more force the nearer the ear was to the source of sound. It has also been well known that difference in pitch was dependent upon the frequency of these blows which the air struck upon the drum of the air; but it was not until recent years known why one sound differed from another in quality; why one man's voice, talking in the same loudness and in the same key, was still a different voice from that of another talking in the same loudness and the same key, or why the vowel sound *a*, pronounced with a certain force and a certain pitch, differed from the vowel sound *o*, pronounced with the same force and the same pitch. The reason of this difference in the qualities which characterize sounds, with respect, not to their loudness and their pitch, but to their quality, to their complexion, so to speak, is found in this: that sounds are complex in their character, made up of different vibrations which are of a certain extent and a certain rapidity, all of them going along simultaneously in the air, some quicker and some slower, some stronger and some feebler, all of them coming to the drum of the ear simultaneously and producing each a different sensation of sound, according as these vibrations differed among themselves.

Your Honor may stand by the ocean and see a small cork floating on the water. The tide is rising or falling, — the great wave that goes around the earth twice in twenty-four hours, — and that cork will rise and fall with it. There may also be long swells of the sea which come from the impact of the winds, and the cork will rise and fall on those; but its position at any moment is dependent both upon the

rise of the tide, or the fall of the tide, as the case may be, and upon this long swell; and its changing position from one instant to another is dependent upon both waves. But over and above all that your Honor will see small ripples on the surface of these large waves, and the position of that cork and its change of motion from time to time is affected by those as well. All of them blended together give for the instant the position of that cork and its change of motion. Now the ear is so framed that it takes the force which is brought to it by the long wave and the quicker and feebler wave with it, and as more or less of those are mingled and fall on the ear in different ways, one sound differs from another sound.

There is another fact which I shall ask your Honor to consider for one moment, and that is that a certain amount of force is necessary to give rise to the sensation of hearing. Sound which is loud to a person near to the origin of the sound becomes very feeble at a distance, and finally the ear may be placed beyond its reach altogether; and yet nobody ever supposed that the vibration of the particles of the air ceased at the point where the ear ceased to take cognizance of them. They shade out beyond that.

These two facts, which I have alluded to, become important in considering whether one telephonic instrument is the same as another or not. Mr. Bell's great discovery was that you could impress upon a current of electricity passing through an electric circuit variations in the strength of that current which would correspond with the variations in the force of the air waves at the time, being that force which was the resultant of all the waves which were passing through the air at a given point and a given instant, That was his great discovery. He called that current an undulatory current, meaning and explaining his meaning to be, a current which in its variations corresponded with the variations of the sound wave, including not merely the great waves which determine the pitch and the loudness of the sound, but those infinitely small waves which give character and quality to it, and which render speech possible, all which the telephone was to reproduce; for if beyond the distance where sounds can be carried in the air those sounds are to be produced, it must be done by reproducing the waves themselves; there is no other way in which the sensation can be caused.

As my brother Storrow explained, it was long known that variation in the strength of the current flowing through a metallic conductor which had been cut in two and its ends brought together, could be made by pressure between those ends, — electrodes they are called, — to be increased or diminished by increasing or diminishing the pressure. Then it was obvious that if you increased or diminished the pressure between the two electrodes brought together, just in the same way as the pressure of the sound waves themselves increased or diminished, you would have a current which would rise and fall in strength just as the sound waves rise and fall in strength, and if that changeable current could be made to put into motion a solid body at some distant point which could in turn give to the air its vibration, its motion corresponding to the first, then you would have in the air at the distant receiver the sound waves like those that had given rise to the sound at the transmitter, and they would produce the sensation of sound on the ear when they fell upon it just as they would have done if they had started from the original source.

Mr. Irwin in this case was not the man who first undertook to utilize this effect of a change of the strength of a current by the variation of pressure between two electrodes; there is no pretence that he did that, no claim that he did that. Indeed that is shown in a prior patent of his own, 206,241, though not broadly claimed as his invention even there. His invention, if it be one, comes at a later stage of the art, and I shall now ask your Honor's attention to Prof. Morton's testimony when he was called upon to point out in what respect the defendant's instrument corresponded with or differed from that described in the first patent. I shall read from the 24th and 25th pages. The usual interrogatory was put asking him to make the comparison, and he says: —

"*Ans.* Comparing the instrument described in the patent referred to with the Blake transmitter, I find in both of them a sound receiving body capable of receiving articulate sounds and converting them into vibratory movements."

He found in both of them a device which he could describe in the same words. Were they, therefore, the same devices? No.

"There are in the case of the Irwin patent, the wooden base of the instrument, and in the Blake transmitter the metallic diaphragm."

Those two things he said he found in common, though they differed. Then there was an interrogatory put to him intended to meet the necesities of the case.

"*Int.* 7. Was a metallic diaphragm" [such a one as he found in the Blake transmitter] "at the date of the said Irwin patent, Oct. 22, 1878, a known form of sound-receiving body in other forms of telephones"?

He says it was. He was not asked whether *for every purpose whatever* they were known substitutes of each other, one or the other of which could be adopted at pleasure in any apparatus.

Now let us see what Mr. Irwin himself says as to these devices, and I ask your Honor's attention to it, as to this first point of correspondence between these instruments; and I ask your attention to the patent 206,241, granted to Mr. Irwin, July 23, 1878. If your Honor will have the kindness to look at the drawings, perhaps it will aid me somewhat.

The patent is near the middle of the volume, the first patent in the volume of the defendant's testimony, page 55. In this instrument your Honor will see there is a wooden base. I refer to Fig. 2 particularly now, and Fig. 3 as well, which is a sectional view of it. There is a wooden base very much like the wooden base on the instrument which has been introduced here as representing the plaintiff's invention, which is the subject of this suit.

From the middle of that base rises a post, and on top of it is a small plate, wooden plate I suppose, but thinner than the base. Between these two there are on the right-hand side of the figure two needles, as they are termed, one or both of which. the patent says, should have a sharp point, and they should have an attenuated point of contact, — a *very* small point of contact, — and they are to have the pressure properly adjusted, and there is a device there for adjusting the pressure by moving the lower carbon up or down, as the case may be. But it is especially to these features that I ask your Honor's attention. It is to a paragraph on the second column of the first page near the bottom.

"The pointed wires" — those needles that I have just referred to — "are therefore set in substantially rigid bases, one or both of which

should be capable of sonorous vibration. Such a base is the plate *g*, which is rigidly mounted upon the post *h* and supported upon the base *i*. The vibration of the plate *g* is sonorous, and it is to be understood that the distinction between the sonorous vibration of a rigid body is alone herein referred to in contradistinction to that species of vibration which characterizes a membraneous or thin metallic diaphragm."

It has long been a well-known fact that solid substances, such as iron and wood, would convey sound like the air; that they conveyed it more rapidly than the air, and convey it by vibrations among their particles like the vibrations in the air, but infinitely smaller in amount. My associate has shown you that Mr. Irwin was familiar with devices where a diaphragm was employed; Mr. Voelker had brought him an instrument at the very outset of his experiments in which a diaphragm was employed. He started upon a new field, to take advantage, not of those swings of a diaphragm, but, in contradistinction to them, of the sonorous vibrations which are found in the particles of a solid body itself. That was the phenomena which he sought to lay hold of in this instrument, and he speaks of it in this patent and states the object of it as being an instrument for the transmission of articulate speech, just the same object which had been accomplished by Mr. Bell, only he sought to do it (probably hoping to find a better instrument) by taking advantage of the sound wave in a solid body itself. Now, our work is to find out whether the instrument invented by Mr. Blake is, so far as it differs from what went before, substantially the same as the instrument patented by Mr. Irwin, and there is often no better way of determining what the character of an invention is than to follow the steps which an intelligent inventor has pursued in starting from that which is known towards that which is unknown. Mr. Irwin in this case knew of this device embraced in his prior patent, and to the next patent I now ask your consideration. In this second patent, 209,266, the one upon which this suit is founded, we have a different instrument from the preceding one, and, for that matter, one very different, in many respects at least, from the defendant's instrument. Let us see what this inventor sought to accomplish, what he set himself about to do. He commences his specification with the statement:

"This invention relates to that branch of acoustic telegraphy whereby articulate sounds, produced in the vicinity of the transmitting instrument, are reproduced and made audible again at a distant point in an electrical circuit."

It *relates* to that. So does his previous invention. Nothing new in that. Bell's invention and Edison's related to that.

"The object of my improvement is to reproduce the exciting sounds without loss of volume, and therefore to render audible within a confined space sounds which, in the free atmosphere, would be inaudible."

That is the thing which he has undertaken to accomplish, to reproduce ordinary sounds without loss of volume; to do even more, to render sounds audible which, in the free air, are inaudible; and your Honor will well appreciate the significance of this when I state that about this time, at any rate it is familiar literature on the subject, Mr. Hughes, in England, found that if he laid a couple of nails together, each connected with an electric circuit, and another nail across them, or two pieces of graphite, such as are found in a common pencil, and a third across, and passed a battery current through them, and included also one of Mr. Bell's telephonic receivers in the circuit, and shut up a fly under a tumbler over that device, when the fly walked across the upper bar it created a sound in the receiving instrument which some person, describing it, said was like the tramp of an elephant over a common floor. Nobody had heard the sound of a fly walking before, so it was a thing which apparently lay quite within the reach of invention for Mr. Irwin to devise an instrument which not only reproduced ordinary sound without loss of volume, but would make sounds audible which in the free air were inaudible. There has been no attempt to show that this Blake transmitter will do either one or the other of those two things. It is a well-known fact that, though it reproduces sounds, it reproduces them with a lamentable loss of volume, and it was never expected of it (certainly there is no proof) that it would make sounds audible which, in the ordinary condition of the air, are inaudible. Mr. Irwin sets himself about to accomplish this result, and he employs the same base, the same sound-receiving instrument, a solid body, which he had employed in his previous device, and not the vibrating diaphragm

which is employed in the Blake instrument. Having devised an instrument which should reproduce the sounds from the sound vibrations of a solid body, excessively minute as compared with those of a diaphragm, he now sought to make that instrument so sensitive that it would, through the same agency, reproduce the sounds without loss of volume, and render audible sounds which were otherwise inaudible. That is the object of his invention, and *his devices have reference to that ;* and therefore he says : —

" *To this end* I construct a battery-circuit with an interposed apparatus consisting of a pointed needle delicately suspended with its point in contact with another needle having a blunted point, whereby the electric current is required to pass the attenuated part of the circuit formed by said needle points in contact and become broken up into undulations by any cause which sets up vibrations in the vicinity of said attenuated portion of the circuit.

" The only cause of vibrations which are of interest in connection with this patent are sounds. When sound waves fall upon the above mentioned needles and their supporting parts, vibrations are set up therein in exact response to the exciting sound waves. These vibrations affect the conductivity of the circuit wire at the attenuated portion by varying the resistance at that point, and sets up a series of undulations in the electric current corresponding to the characteristics of the sound waves, and these undulations affect an instrument of suitable structure at another point in the circuit, to reproduce isochronous vibrations and duplicate sounds."

I ought to mention the fact in this connection, that both Prof. Morton and Prof. Cross agree that these sound waves, these sonorous vibrations in a solid body, are distinguishable from the vibrations of a plate in being greatly less, and in being those which are characterized properly by the term "molecular vibrations." Mr. Blake has never set himself to work to devise an apparatus which would take cognizance of this molecular vibration, and, if he has attempted it, he has failed to produce an instrument which will reproduce sound without loss of volume, or render sounds too feeble to be heard by the ordinary ear, audible. I asked Prof. Morton, in order that there might be no mistake about this matter, what the meaning of this passage was which I have just read, as to the object of the invention (p. 38) :—

"*Cross-Int.* 18. What is your understanding of this passage in the specification: 'The object of my improvement is to reproduce

the exciting sounds without loss of volume, and therefore to render audible within a confined space sounds which in the free atmosphere would be inaudible'?

"*Ans.* The phrase seems to be very obscure."

It was rather necessary for him that it should be obscure, because under that obscurity he might perhaps claim that the two instruments were alike; but if the object was a definite and distinct one, he could not find it in the Blake transmitter. However, he went on: —

"The phrase seems to be very obscure, and to describe two different things in its first and second portions. The first part conveys to me the idea that the writer wished to claim for his apparatus the characteristic of all microphones; that is, that it did not produce at the receiving end a less sound than that which was received at the transmitter. The second part of the paragraph conveys to me the impression that he claimed what is one of the general properties of all telephones, namely, rendering audible in the receiver sounds which, if simply transmitted by the air from the place where they were uttered, would be entirely lost; or, this last phrase might mean that a faint sound might be reproduced with even greater intensity in the distant receiver."

Now, what did Mr. Irwin say about this matter? In the second patent, the one which this suit has been brought upon, he referred to it. But I should mention, before speaking of that, that on the sixth day of January, 1879, he obtained a patent for an invention which consisted simply in the substitution of a thin metallic plate for a wooden base. The needle and the way of supporting it by a coiled spring were all the same. He thought that he had made an invention when he had substituted one for the other. They were not known substitutes. If they had been, there could have been no invention in putting one of them in place of the other, the rest of the apparatus being the same. He made it, therefore, still more sensitive than before, and then we have another patent in which he speaks of the first one on which the suit is brought in this way. I read from the second patent in suit, No. 225,388: —

"The adjustments of the points of contact and resistance to produce the desired effect are exceedingly delicate, and it is a desideratum to obtain such an adjustment and such qualities of vibration as will enable the instrument to respond to vocal articulations uttered in a low tone close to the sensitive medium without being capable of

responding to all of those sounds which are ordinarily so delicate as to be *inaudible to the unaided ear*. The reason for this is manifest, because an instrument may be capable of transmitting all of the articulate sounds of words spoken in its vicinity, and also capable of transmitting a great multitude of sounds which are practically inaudible in themselves, but are *made audible* to the listener at the receiving instrument, and with the effect there of confusing the words spoken at the transmitting instrument, so that it is difficult for the listener to separate the articulate sounds from the inarticulate ones."

In other words, having set himself at work in the first patent, on which the suit was brought, to devise an instrument which would render audible, sounds which were otherwise inaudible, he found that they so mixed themselves up with articulate sounds which men want to hear as to destroy their character. That is precisely what he undertook to do.

There might be useful purposes in reproducing, or in rendering, audible sounds which are not audible ordinarily; but when those sounds mix themselves up with the sounds of the human voice, which it is desirable to reproduce so that they shall be known and characterized, then they become a nuisance. This very feature, then, which he had introduced into the first patent on which this suit was brought, was a thing which he found it necessary to get rid of or to neutralize. Now, am I not right in saying that, with Mr. Irwin, whatever the fact may have been with Mr. Morton, it was perfectly true that the object of the first patent was to render sounds audible which were inaudible, and when he found that they mixed themselves up with sounds which he wanted to hear in their integrity, he had to eliminate that element out of his instrument, and in some way put it back into the same state in which Blake's has always been? What, then, did these two men do? One of them — Mr. Blake — started with the thin diaphragm, and an electrode held against it by a spring pressing laterally against it, as in Edison's application 141. It might seem from his patent that he was unaware of the fact that anybody had used such a spring as that before; but it is now obvious that such a spring had been used before. He had the metal diaphragm, and the electrode pressing against that to produce a varied state of pressure as the diaphragm moved, and he undertook to make that instrument better. Connected with the dia-

phragm, he had an electrode, which was a blunt electrode, not a pointed one. and, though it was platinum, it was in no sense a needle. That is the electrode which is to move to and fro with the plate. He separated it from the diaphragm for another purpose, so that there might be no break between the two electrodes; that is, so that when sometimes the diaphragm, under abnormal circumstances, would produce a break, the break would take place where it would do no harm, and not in the circuit. But nothing turns upon that, so far as this case is concerned. He had to start with the thin metallic diaphragm, with a blunt point upon it, as an electrode.

The counsel for the complainant seem to think that an electrode, with an area coming in contact with the opposite electrode, of one sixty-fourth of an inch in diameter, was a sharp-pointed electrode. For some purposes an instrument as sharp as that might be called a sharp-pointed instrument, but take a needlewoman with her steel needle reduced to a point, and break it off at a place above the point where it would be one sixty-fourth of an inch in diameter, and, for the purpose of sewing, will she call that a sharp, or a blunt needle? It is a blunt needle. It is a blunt electrode and not a sharp needle point which Mr. Blake has used and which has constantly been used in his transmitter. He sought to modify the spring which carried or governed the other electrode, pressing against it sideways so as to make it more efficient, and he loaded that spring with a weight so that it would bend and control more the action of the diaphragm and give the pressure between them as the electrode moved a new character from what it would if the weight was not there. Your Honor can easily see that if a point moved against a fixed body with a certain force, the rise of pressure must be very sudden. If it is pressed against a spring, the spring may yield so that the rise of pressure will be very small. If you load that spring, and it has to do more work, then the pressure may rise more; and that is what Mr. Blake did. He used the device shown in the instrument before your Honor, Mr. Edison's, which the plaintiffs themselves have reproduced from the description, and the device No. 10, which Mr. Morton and Mr. Irwin both agree do not contain this invention, — he took that kind of spring electrode and undertook to make it better, and that is all. Mr. Irwin

never undertook to do that until long afterwards. Prof. Morton undertook to draw a distinction between these two, because he says that the spring which is used in the Blake transmitter, though of the same kind precisely as that which is used in instrument No. 10 and in the Edison instrument, was not so stiff a spring as what is shown in those instruments. Certainly there is nothing to show that the Edison spring is stiff, but even Prof. Morton admitted that that spring is the only thing which operates to press that electrode against the other; that in Edison's and Blake's device the spring is one which entirely controls the electrode. It is not so in the Irwin device; the spring does not control the electrode except in one particular, and that is as to the force with which gravity shall press downwards upon it. In Mr. Blake's instrument gravity does not come into play at all, nor in instrument No. 10, nor in Mr. Edison's instrument. Inertia comes in in all of them to a greater or less degree in proportion to the mass to be used. Mr. Edison, in one of his patents, points out the function of inertia long prior to anything Mr. Irwin had done, I think.

There is not a word, as my brother Storrow showed, in Mr. Irwin's patent about inertia as playing any valuable part, or any part, in his apparatus; that he had in any way employed inertia different from what other people had employed it; but if he had he should have described it; the law required him to do so; if that was a part of his invention he did not do what the law requires him to do in order to include it in the grant made by his patent. But if he did employ inertia, how and to what extent did he employ it and for what purpose, assuming it to be so? Why, to reproduce sounds without loss of volume, and to render sounds audible which were otherwise inaudible, and no employment of inertia which falls short of that, it having been employed in other apparatus, will come within the scope of his invention, if his invention rested upon that. For it sometimes happens that a patentee may not be able to describe in figures the exact amount of force which is required, or the exact amount of inertia which will be required, or the mass of a particular part; but he can tell you that if you make it of the right mass you get a certain result, and when you get that result you will have his mass, or his inertia, and not until then; and so when he tells you the object of his invention, if that object depends upon inertia, you only have the inertia

in the way in which he employed it when you find you secure that object.

But that there may be no mistake about this object of Mr. Irwin's invention, this second patent (No. 225,388) contains another passage referring to the first patent: —

"The instrument constructed as described is capable of transmitting sounds *so delicate that they are inaudible to the unaided ear;* and the purpose of my invention [that is, of this second patent] is to modify this capacity so that said disk [for he had now got the disk into his instrument] will be less sensitive and only transmit the articulate tones of the voice."

Now, is not that a clear distinction between the objects of the two inventions? In the first one, the one which he says we infringe, he sought to accomplish a certain object, and, for aught I know, did accomplish it. In the second one he undertook to get rid of just that thing, and make the instrument adapted to the human voice alone and not to the inaudible sounds which confused the action of the instrument for the purposes of the transmission of speech. In the instrument described in that first patent, Mr. Irwin did not undertake to modify the sound-receiving base of the instrument, or the electrode connected with it. His inventions all clustered around the other electrode. He undertook to do something to it which would enable it to do something which it did not do before, and that something I have pointed out. There are seven claims in that patent. Not one of them refers to inertia. They are drawn with minuteness; every one of them specifies the needle; and every one of them specifies the free suspension of the needle in one form or another. This new mode of suspending the needle by hanging it upon a coiled spring delicately, and providing it with a sharp point, for the purpose of taking cognizance of phenomena which ordinary instruments would not, and to produce a result which they would not, is the subject of these seven claims. When he swung his needle up in that way upon that spring he took it so far out of the control of the spring itself, away from the character of the electrode support which is found in instrument No. 10, and in Edison's previous instrument, the last of which is a practical instrument, that he had to introduce guides for supporting it, so that this delicately sus-

pended needle would not tip over one side, — this spring was so very sensitive that it would not hold the needle in place.

That is the thing which is compared with Mr. Blake's instrument where the electrode carried by the spring is held in place only by the spring, and by just such a spring or of the same kind as is shown in the Edison instrument and in instrument No. 10. He had to put guides in there because he purposely made his spring so delicate that it would not support the needle. More than that, he sought for a degree of delicacy in the way in which he suspended it which made it necessary for him to protect that needle against even passing currents of air, — not against sound waves, — and so he introduced a glass tube which he makes the subject of a claim as a part of his invention (claim 7). Now, nothing of that kind is required or would be admissible in the Blake instrument. To give his instrument the degree of delicacy which was required, which was essential to its doing what he said he wanted to do, Irwin had to provide guides to support it instead of the spring, and a glass tube surrounding it to protect it from the currents of air which might come in contact with it and deflect it out of its place. That is the character of the device which he introduced in combination with the solid base which was to take cognizance of molecular vibrations in contradistinction to the vibrations of a diaphragm. Could two instruments differ more widely in purpose and in the conditions and devices by which that purpose was accomplished? What could Mr. Blake have learned from that instrument if he had had it before him which would have enabled him to take advantage of anything which Mr. Irwin had taught the world? If he had undertaken to accomplish the same object, he might perhaps have copied the means, but he had not before him the same object; he had not before him the same class of instrument; he had not *the same sensitive* vibrating body which was to receive the sound waves; he had not the same spring, but he had a spring of the kind which Mr. Irwin and Prof. Morton both say did not involve this invention, and did not involve it, so far as I can see, because they say it is not sensitive enough. Stretch out that coiled spring in that Irwin instrument which the plaintiffs themselves made, so that you can see its size and its length, and compare that with the spring in the Blake transmitter, and see if there is any comparison. See if it is not — I had almost said infi-

nitely — more delicate and less capable of affecting an electrode than that in the Blake instrument. See if it does not differ far more widely from the Blake spring — and because it had a special object in view — than the spring in the Blake instrument differs from the spring in the Edison instrument and in instrument No. 10, where it was put for exactly the same purpose, to control the electrode wholly and completely.

May it please your Honor, I have dwelt at some length upon the general purposes declared in this patent and upon the general character of the devices by which it professes to accomplish them. It is your Honor's duty to compare the instrument of the defendant with the instrument described in the plaintiffs' patent. You are not merely to inquire whether there is something in common between them; you are not merely to inquire whether for the practical transmission of speech one is as good as the other; you are not merely to inquire whether the differences between them are or are not mechanically so great or so small that in some ruder instruments, or even in telephones, the change from the one to the other will or will not render the apparatus inoperative. You are to inquire whether the one attains the novelty in results of the other by the same means as the other. We are particularly concerned to compare the shape of the electrodes and the manner of supporting them in order to determine the question of identity in these features for the purpose of this invention; and in order to ascertain the extent of the physical changes which come within Irwin's invention, it is essential to consider that it consists in the introduction of special devices for the purpose of utilizing *sonorous* vibrations of a solid body to reproduce feeble sounds without loss of volume. I do not mean to assert that the sonorous vibrations, which a rigid base or which the needles and their supporting parts take up from the sound waves of the air, are for all purposes essentially different from those of a thin metallic diaphragm. They have the same form of vibration excited in them by the same cause, and for the general purpose of transmitting speech by electricity one is a substitute for the other. But the attainment of this general purpose is not the object of Mr. Irwin's invention, for it had already been attained. His invention was to introduce special variations in the parts which cluster around the point of contact in order to modify the result in a special way

and to a special end. If our devices are not Chinese copies of his, they are not literally the same; if, by reason of those differences, they are not capable of fulfilling, and are not used to fulfil the declared purposes of his improvement, then they are not substantially the same for the purpose of his invention.

In the patent 209,266, which is the first one involved in this litigation, Irwin retained the needle electrodes of platinum and carbon, one sharp and the other blunt, which he had described in his previous patent; he retained the thick sonorous base with an electrode adjustably connected with it; he did not adopt a thin metallic diaphragm. He described a device or means of holding the other electrode; namely, the sonorous base of his patent 206,241. He did not use the flat spring of his instrument No. 10, and Edison's instrument. He discarded those instruments; he adopted new means of supporting the upper electrode and of making it act in combination with the other electrode. He substituted for the flat spring an exceedingly delicate coiled spring, which allowed the needle to press with a part only of its weight upon the electrode below by the force of gravity, a force which does not operate in the Blake instrument at all. He thus brought gravity into play for the first time, so far as appears in this record, in instruments of this class.

Now, one word in regard to the second claim of this patent, which is a claim to: —

"2. An attenuated point in a battery circuit composed of a freely suspended needle, the point whereof rests upon the blunt point of an opposite needle with an adjustable pressure, as set forth."

Strictly speaking, that refers only to the attenuation, without reference to the variation in pressure which is requisite for producing any result. But the degree of attenuation which is to result from the size of the point and of the parts in contact and the pressure between them, must be such as to reproduce sounds without loss of volume, and render audible sounds which would otherwise be inaudible. That is the kind of attenuation which he sought to produce by a sharp point and a slight pressure between them, by that degree of attenuation as distinct from the attenuation which had been found in the previous instruments as the instrument of Voelker, and in Edison's instrument and in instrument No. 10. If there was

any difference in the attenuation, it was a difference which had reference to that result, and his degree of attenuation was not reached until that result was reached.

One word, may it please your Honor, in regard to the second patent. There are some passages in Prof. Morton's deposition which I am anxious to call your Honor's attention to, and I refer to pages 38 and 39 : —

"*Cross-Int.* 45. In the patent of March 9, 1880, No. 225,388, to which your attention is called, I find in the third claim and in other parts of the specification reference to a vibrating disk having free edges and capable of vibrating bodily. What do you understand this bodily vibration of the disk to be?

"*Ans.* A motion of the disk as a whole, unimpeded by the strains developed where its edges are rigidly held.

"*Cross-Int.* 46. I find a passage in the body of the specification as follows: 'Disks G and I are not rigidly confined at their edges, and are therefore capable of motion bodily to and from each other, so that under the impact of sound waves the said disk may move without buckling at some point between the centre and the edge, and therefore short nodal points are designated in the vibration of these disks, and disks of larger size than usual may for that reason be employed.' What do you understand this buckling under the impact of sound waves to be, and what the movement bodily to be, without the buckling?

"*Ans.* To make this clear, I would mention in the first place that sound waves, as transmitted through the air, are quite sizable things. Thus a medium note, the common *c*, has its waves about two feet long. When such waves strike a plate held tightly at its edges they push and pull against it, bending it inward and outward, but the clamping of the edge causes this bending to produce a strain known as buckling, by which the character of the motion of the plate is modified, and when this motion is, through the intervention of the current, again translated into sound, that sound will differ from the first more or less in those delicate inflections which constitute the finer characteristics of articulate speech. If the edge of the plate is not thus rigidly confined, it would receive the wave impulse and move in obedience to it without any such strain and modification, and thus be effective in more accurately reproducing through the agency of the current the original sound. By buckling, I understand an action well known to mechanics, and involving an unequal state of tension produced in a plate, either temporarily or permanently, by bringing a strain upon it in such a way that it cannot yield uniformly; thus, for example, a plate of any shape rigidly held in a horizontal position by its edges, buckles if a sufficient

weight is applied at the centre, because at some points this will produce a compressive, and at others a tensile, strain very different in their amounts and directions, and thus destroying the homogeneous character of the plate."

Now, I ask your Honor to observe that the object of this invention is to make a plate move in exact conformity with the sound wave, the whole of it, so that it shall not by unequal movement in some parts as compared with the others, produce different waves from those which fell upon it. That is the object of the invention.

"*Cross-Int.* 47. Do you understand the condition called buckling by mechanics, in a circular plate, for instance, takes place only when the periphery of the plate is tightly clamped, and that it does not occur when a strain is brought upon such a plate when its periphery is free?

"*Ans.* I do not, but only cite the case of the clamped edge as developing the buckling action in the most prominent way. If a circular plate rested on a ring, and a heavy weight were applied in the centre, buckling would also occur. The essence of this action, as I understand it, consists in the production of unequal strains in adjacent portions of the plate, and would be equally produced, for example, by unequal heating and cooling of the centre and edges of such a plate.

"*Cross-Int.* 48. In the passage that I have just quoted, we have the expression with reference to two disks in the instrument, that they are capable of motion bodily to or from each other. What I wish to understand is, what this bodily motion to and from each other is, as distinguished from some other kind of motion which is not bodily motion to and from each other?

"*Ans.* It means a motion of the entire disk or disks by which their distance apart at all points is uniformly increased or diminished, and differs from the motion which they would have if their edges were rigidly clamped, as a matter of approach and recession, simply in this, that in this case the centre portions would approach and recede more than their edges. The difference of these motions, however, which I consider the most important in the present case, is that which has reference to their transmission of sound, which, as I explained in my previous answer, would consist in this, that in the first case, the sound motion would be transmitted unchanged in its character, while in the second case it would experience a modification produced by the strain developed by the buckling of the disk."

That is the object of the invention to reproduce sounds in their integrity as to character, without any of the distortion of the sound waves which would come from a distortion of the plate.

"*Cross-Int.* 49. I can easily conceive of a circular plate being moved in the direction of its axis without any bending, and so that in its several positions through the distance that it moved each position which it occupied would be parallel with all the other positions, and I should understand this to be a bodily movement of the plate. Would you so understand it?

"*Ans. I should. And I think that my previous descriptions tend to convey the same idea.*

"*Cross-Int.* 50. I can also readily conceive of a circular plate resting on a ring loosely, and that a pressure on the plate on the side opposite the ring would press the plate against the ring, and might bend the plate at the centre so that some parts of the plate would move while the circumference remained stationary; and I can also conceive that a plate tightly clamped between the rings at its circumference might, when pressure was applied to one side, bend under the pressure. Now, in both these latter cases, would not strains occur between the circumference of the plates and the centres which would not occur when the plate was moved bodily in the manner stated in my previous question?

"*Ans.* In the last of the cases such strain would undoubtedly always occur, but in the other its occurrence would depend upon the closeness of contact between the edges of the plate and the ring and the intensity and duration of the applied force. If the contact of the edge of the plate and ring were attended by little or no initial pressure, and if the force supplied to the plate were feeble and of brief duration, the plate under these conditions also would be practically free to move bodily to the extent required for transmitting the sound motion, just as in the first case of all, which you stated in the previous question. When, however, the edges of the plate were clamped fast to the ring, an initial pressure is brought on the edges against the ring, which renders any such motion out of the question.

"*Cross-Int.* 51. If the force applied to two plates, held respectively in the two ways last supposed, did actually bend out of their normal planes under the pressure applied, would strains occur in each between the circumference and the centre?

"*Ans.* They would; though they would be greater in the second case than in the first.

"*Cross-Int.* 51. Do you understand that in the instrument described in the patent we are now considering the two disks are capable of *moving bodily to or from each other, defining such movement as we have done*, and without any bending of the plates out of their normal planes, and without any strains between their circumferences and their centres?

"*Ans. I understand from the description of the patent that such is intended to be their condition*, and I conceive it quite possible that such an effect might be maintained with the apparatus, figured within the very narrow limits called for in the transmission of sound

vibration. As I have never tested this apparatus, I cannot say what is their actual condition.

"*Cross-Int.* 53. Have you ascertained by actual observation that in the Blake transmitter this bodily movement of the vibrating plate actually takes place in the transmission of sound without any bending of the plate or any strains between the circumference and the centre, different from what it has when at rest?

"*Ans. I have not.*"

And that is the proof of infringement. Prof. Cross was interrogated in regard to this plate in the Blake instrument, and he showed conclusively that the bending did occur, and that this movement to and fro, which was sought for for a definite purpose, that of reproducing sounds without change, was not to be found in the Blake instrument, and, on cross-examination, Mr. Morton admitted that this explanation of Mr. Cross was the correct one, though he undertook to show that he had never intended to claim or to contend that the plate should move without any buckling. Whatever he may have contended for, in explaining the patent and what it means, and the object which was to be had in view, he certainly did point out that the plate was to be moved in all cases parallel to itself, and then for a definite object, and that this was set forth in the patent as the invention it was granted for.

Now, if your Honor will pardon me one moment more I will be done. On page 89 of the record we have a letter which was sent by Mr. Irwin to the Patent Office for the purpose of obtaining this claim. It is at the bottom of page 89 : —

"Herewith I hand you such amendments as appear to be required by the objections made in your letter of 7th inst. Claim 1 specifies a *freely* vibrating medium. The specification makes it clear that *freely* refers to a medium which is not *under tension* clamped and rigidly held. This does not apply to Edison, Gray or Maxwell, all of whom have media which are *under* tension, being clamped at their edges.

"Claim 3" — which is the one we are sued on —

Mr. BETTS. — No ; it is not.

Mr. SMITH. — So far as it describes the character of the motion it is literally the present claim. It says that the plate is one which is "capable of vibrating bodily." What is this "vibrating bodily"?

If my brother says he has now got a combination claim, what must one of the elements of that combination have?

"Claim 3 is for a diaphragm or disk unclamped at its edges so that it may *move bodily with its surface in parallelism.* This is not the case with either of the instruments referred to."

I care not whether this claim is to the disk alone or to the disk in combination with something else. In either case it was a disk which was to move in parallelism to itself, and there is no pretence that in the Blake transmitter the disk does so move, or that the result which Prof. Morton says was to be obtained by that kind of movement is found in the Blake instrument. In no instance have they made an attempt to test the Blake instrument in comparison with the Irwin instrument to see if it embodied devices which produced the same result which the patents declare, or the experts declare, are the objects of these inventions. Prof. Morton agreed that in the instruments which are known as magneto instruments such as the previous instruments of Phelps, Gray, Dolbear and Bell, it was important, if possible, that the plate should move in exact conformity with the sound waves in order that the reproduced sound waves should be like those which produced the motion, and it is equally important and just for that purpose that Prof. Morton says Mr. Irwin's instrument is devised, that it shall have a kind of motion which will produce a result that cannot be produced by any other kind of motion in either class of instruments.

All this is in addition to the proof in the record referred to by my associate, and which shows that whatever is in common between the two in this respect was used by Mr. Blake before it was invented by Mr. Irwin.

ADDENDUM.

The complainants' counsel in his reply asserts that we have not produced the evidence of experts to prove that the two instruments are different. He misapprehends the record and misconceives the law. Under each head — the attenuated point, the employment of gravity, the "bodily vibration" — the *complainants'* expert stated what was the essential feature of their patents, and testified what alleged peculiarity he thought he found in our instrument which enabled him to

form the opinion that ours resembled theirs. We show that he is mistaken in his observations of our instrument; and that ours does not possess those peculiarities of shape and structure which he says are characteristic of their instrument and important in its operation. There we might rest.

But beyond that, Prof. Cross points out the elements Irwin employs and testifies that they do in fact give to the Irwin instrument the precise character which his patent claims for it, and that the Blake does not have these special elements, and does not have that special character.

On the intrinsic importance or value of some of the changes introduced by Irwin we cannot truly dwell, because we are not impressed with the practical value of the novelty in results which he sought and which he attained. But that an instrument is the better for not securing those results nor the special devices introduced to obtain them is not proof of infringement.

Alexander Graham Bell, the Inventor of The Electric Speaking Telephone. 1881. The Making of Modern Law: Trials, 1600–1926, link.gale.com/apps/doc/Q0101789291/MMLT?u=wisc_madison&sid=gale_marc&pg=1. Accessed 23 Apr. 2024.